TimeTools

SR / SC Series
Network Time Protocol Server

USER GUIDE

Models Covered:

SR9850	
SR9750	SC9705
SR9210	SC9205
SR7110	SC7105

Firmware Revision 1.0.004a onwards.

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Table of Contents

Introduction **5**
Key Features 5
Key Benefits 5
Network Time Protocol (NTP) **6**
NTP SR\SC Series Hardware **7**
Power 7
Console 7
GPS and LF Antenna Connection 7
Ethernet Network 7
Rear Panel 7
Rear Panel Connectors 8
Rear Panel Status LED's 8
NTP Synchronisation **9**
Stratum 1 Operation 9
Loss of Hardware Clock Synchronisation, TCXO Models (SR9750, SR9850, SC9705) 9
Loss of Hardware Clock Synchronisation, Non-TCXO Models (SR7110, SR9210, SC7105, SC9205) 9
NTP Peering 9
External Backup NTP Servers 9
Local Clock 9
Typical Synchronisation Hierarchy 10
LF Radio Transmitter Coverage **11**
LF Radio Antennas 12
MLS \ DLS Antenna Installation 12
MXS \ DXS Antenna Installation 12
Typical Maximum GPS Cable Length (TWS3978 GPS Antenna) 14
SRxxxx-10 and SCxxxx-10 High Sensitivity GPS Receiver 14
GPS Amplifier 14
Surge Suppressors 14
GPS Time Acquisition 14
SR Series Configuration **16**
Default Configuration 16
Web Interface **17**
Network Configuration Menu 20
Security Configuration 21
NTP Configuration Menu 22
Log Messages 24
Uploading User Generated SSL Certificates **26**
Console Configuration **27**
RS232 Console Configuration 27
Dumb Terminal Configuration Settings 27
Telnet Session via Remote Host 27
Secure Telnet Session (SSH) via Remote Host 27
Logging On 27
Configuration Menu 28
Network Configuration Menu 28
Security Configuration Menu 29
NTP Configuration 29
System Control Menu 30
System Log (SysLog) Messages **31**
Updating SR Series Firmware **32**
NTP Authentication **33**
Symmetric Key Cryptography 33
NTP Keys 33
Trusted Keys 33
SR Series NTP Server Operation – LCD Display **34**
LCD Display – Initial Power-Up 34
LCD Display – Initial Operation 34
LCD Display – Normal Operation 34
LCD Display – Device Unsynchronised 35
LCD Display – Internal Manual Time Adjustment Required 35
Correcting the System Time **36**
SR Series System Logs **37**

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Appendix A: Specifications **38**
Appendix B: DATASHEET - SR SERIES **39**
PRODUCT OVERVIEW 39
Product Comparison Chart 40
GPS and LF Antenna Options and Accessories 41
Product Codes 41
Appendix C: DATASHEET - SC SERIES **42**
PRODUCT OVERVIEW 42
Product Comparison Chart 43
GPS and LF Antenna Options and Accessories 44
Product Codes 44
Appendix D: Optional LF Radio Antenna **45**
MLS \ DLS Antenna Installation 45
MXS \ DXS Antenna Installation 45
Appendix E: Optional High-Gain GPS Antenna **46**
Appendix F: Optional GPS Surge Suppressor Specification **47**
Appendix G: Copyright and Permission Notices **48**
Network Time Protocol (NTP) 4.2 48
GNU Public Licence 48
Appendix H: Warranty **54**

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Important Note:

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

For PLUGGABLE EQUIPMENT, the socket outlet shall be installed near the equipment and shall be easily accessible.

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Introduction

Network Time Protocol (NTP) can be used to synchronize the time on network clients, across an IP network, to the correct time of an NTP time server. TimeTools SR Series NTP Servers provide a stratum 1 NTP Time Server for ensuring the time is correct across an entire network.

The SR Series Network Time Server acquires time from the MSF or DCF-77 Radio Signals or GPS satellite constellation and distributes time across a network using the TCP/IP Network Time Protocol (NTP).

Network managers appreciate the fact that the SR\SC Series is a complete time server housed in a self-contained rack-mountable unit (SR series) or compact enclosure (SC Series).

Cost savings are achieved by the simple configuration and installation compared to configuring a conventional workstation as a time-server. Savings continue with the elimination of software upgrade costs and network synchronization management.

Key Features

- Stand-alone dedicated Stratum 1 NTP Time Server.
- Robust 1U high, rack-mountable enclosure (SR) or compact enclosure (SC).
- Linux based, fully static design, **no unreliable hard disk drives.**
- Convenient front panel display, detailing time, and signal integrity (SR series).
- 10/100 Base-T Ethernet connectivity.
- Can accurately synchronise the time on any NTP or SNTP compatible client including: Windows 95,98, ME, NT, 2000, XP, Novell 5 & 6, UNIX and CISCO Routers and Hubs.
- Web, Telnet, FTP and RS232 remote configuration.
- Secure HTTPS and SSH remote configuration (SR9xxx\SC9xxx models).

Key Benefits

- Highly reliable and secure source of time for your Network.
- Easy to install, configure and maintain.
- Accurately synchronize mission critical network operations and applications across thousands of network clients.
- Secure source of time inside your firewall.

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Network Time Protocol (NTP)

NTP is a computer network protocol which is used to synchronise time on computers across a network. NTP stands for Network Time Protocol. Dr David Mills of the University of Delaware invented it over 25 years ago. He saw a growing need to synchronise time on computers. Now, many distributed computer processes and applications rely on precise system time. Transaction processing, event logging, CCTV and DVR applications all rely on accurate time stamping.

NTP has a hierarchical structure. At the highest level, or stratum, are precise hardware clocks, which can synchronise to highly accurate external time references, such as GPS or national radio time and frequency broadcasts. These hardware clock devices are known as stratum 0 devices. A stratum 1 time server obtains time directly from a hardware clock and is the most accurate reference in the NTP hierarchy. All lower stratum devices obtain time from the stratum above over a network. As the network introduces timing discrepancies, lower stratum devices are a factor less accurate.

A hierarchical structure allows the overhead of providing time to many clients to be shared among many time servers. Not all clients need to obtain time directly from a stratum 1 reference, but can utilise stratum 2 or 3 references. This has obvious advantages in large networks, such as the Internet, to spread the load. However, in practice, on small networks, all clients can obtain time from a single stratum 1 time server.

NTP generally operates on a client-server basis. A network time client periodically requests time from a time server. The time server responds with a packet of information containing a time stamp. The time stamp is then used by the client to synchronise its system time. Complex algorithms are used to calculate the time a packet takes to get to the server and back-again, so as to eliminate or reduce any timing inaccuracies introduced by the network itself.

NTP uses UTC (Universal Time Coordinated) time, which is very similar to GMT time. It knows nothing of local time zones or daylight-saving time. It is a function of the time client to apply an offset to the supplied time to adjust for local time. In this manner, a time server located anywhere in the world can provide synchronisation to a client located anywhere else in the world. It allows clients to utilise different time zone and daylight-saving properties.

The protocol is fault tolerant, its internal algorithms can automatically select the best of a selection of external time sources to synchronise to. Also, multiple references can be peered to minimize any accumulated timing discrepancies. Depending on network traffic and the accuracy of the server, most clients can be synchronised to within a couple of milliseconds of the correct time.

Most modern operating systems support either the Network Time Protocol (NTP) or Simple Network Time Protocol (SNTP) in some form or other. Originally developed for Linux, it has since been ported, in various forms, to UNIX, Netware and Microsoft Windows. SNTP is a simplified form of the protocol; it does not have some of the complex algorithms to maintain high precision time. However, the two protocols are entirely interchangeable – a SNTP client can synchronise to a NTP server.

A number of external time references are available that can be used as a hardware reference clocks for NTP. The most common being GPS. The GPS system is a constellation of 24 orbiting satellites, primarily used for positioning and navigation. However, the GPS system also provides very precise timing information. GPS signals can be received anywhere, provided that an antenna can be located with a good view of the sky. There are also a number of national radio time and frequency broadcasts available: WWVB in the US, MSF in the UK and DCF-77 in Germany. These broadcasts provide an accurate source of time within, and local to, national boundaries.

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NTP SR\SC Series Hardware

The SR\SC Series is complete NTP time server housed in a 1U high rack-mountable enclosure. It has a 40 character by 2 line backlit LCD display for status and configuration information. The rear of the unit has 5 connections: RJ45 LAN, GPS antenna, LF/aux port, console and IEC power inlet.

Power

Integrated Universal 100-240 VAC, 50-60 Hz CE/UL/CSA Approved PSU
Standard double fused, switched, IEC inlet.
Power consumption: approx 5W

Console

RS232 9-Way 'D' Type connection for status and configuration via dumb terminal emulator (Windows Hyper-terminal).
Terminal settings: 9600 Bits/Sec, No Parity, 8 Data Bits, 1 Stop Bit.

GPS and LF Antenna Connection

LF: MSF-60 \ DCF-77 Radio Antenna. RS232 9 Way 'D' type connection.
GPS: TNC connection for 5 Volt GPS antenna

Ethernet Network

10/100 BaseT RJ45 Auto sensing

Front Panel (SR Series)

SR Series Front Panel

Forty character by two line high-contrast blue backlit LCD display. Showing current UTC time and date, current offset to external reference clock, synchronisation status, GPS status and number of satellites used, LF radio signal quality and last successful decode.

Rear Panel

SR Series Rear Panel

SC Series Rear Panel

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Rear Panel Connectors

IEC Switched Mains Inlet	Double Fused, Switched, IEC mains inlet, 100-240VAC, 50-60Hz 0.1A, Fuse: 2x T 0.315A LBC 250V
TNC GPS Antenna Connection	50 ohm TNC female connector to 5 volt GPS antenna. There should be 5V between the centre pin and outer barrel of the connector, which should be present all the way up to the GPS antenna. If 5 volts is not present at the antenna coax connector, it generally indicates a break in the cable. Any break in the cable is generally where the RF connectors are joined to the coax.
LF/AUX Input	9-way D-type female. Pin 3: RS232 level NMEA GPS output Pin 5: GND Also accepts MSF \ DCF-77 LF radio antenna. (SR-MXS-00, SR-DXS-00)
LAN	10/100 Mbit BaseT RJ45 Auto sensing
CONSOLE	9-way D-type female. RS232 Serial Console connection for device configuration using dumb terminal emulator (eg. Hyperterminal). Null modem cable supplied for connection to standard 9-way PC serial interface supplied.

Rear Panel Status LED's

LF LED (Yellow)	Pulses in-tune to the MSF or DCF-77 LF radio time code broadcast when a LF radio antenna is connected (SR-MXS-00, SR-DXS-00). When a good radio signal is being received, the LED should provide a steady, regular, one-pulse-per-second flash. If the LED flashes erratically or is completed on or off, it indicates that a weak signal is being received. In this instance the radio antenna may need to be repositioned or relocated. Pulse width: 100ms\200ms\300ms.
PWR LED (Red)	Mains power has been applied to the device.
GPS LED(Yellow)	Pulses one-pulse-per-second when a GPS lock has been achieved. This pulse is used as a highly accurate reference for synchronisation. Pulse width: 50msec.
GPS Antenna LED (Red)	The red LED next to the GPS antenna connection, when illuminated, indicates that there is a cable fault to the GPS antenna. The LED is illuminated when there is a short-circuit between in the inner-core and outer-sheath of the coax cable to the antenna. The coax cable should be examined for faults.

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NTP Synchronisation

On power-up NTP generally starts in an unsynchronised state. Network time clients will be unable to obtain time from the device until it has synchronised its internal clock to a time reference. To synchronise its internal clock the device needs to be provided with an accurate source of time. Generally accurate time is provided by a GPS or LF radio external time reference, however, you can also configure the NTP server to synchronise to other NTP servers or use its internal real-time clock as a time reference.

Stratum 1 Operation

Stratum 1 operation of a NTP server is only guaranteed by synchronising the device with external hardware time references such as GPS or LF radio. These external hardware time references can be considered to be stratum 0 references – the highest stratum in the NTP hierarchy.

In order to maintain stratum 1 synchronisation, a NTP server must be supplied regular precise time-stamps by an external hardware reference clock, such as a GPS or radio time reference.

Loss of Hardware Clock Synchronisation, TCXO Models (SR9750, SR9850, SC9705)

In the event that GPS or LF radio time references fail, models with a TCXO oscillator will maintain stratum 1 operation for a holdover period of 24 hours. When the holdover period expires, they will fall back to using any alternative external NTP time references that may be configured, changing stratum accordingly. If no alternative external NTP time references are configured, or if they fail, stratum 1 operation will cease after a further 9 hours and the device will enter an unsynchronised state.

Loss of Hardware Clock Synchronisation, Non-TCXO Models (SR7110, SR9210, SC7105, SC9205)

In the event that GPS or LF radio time references fail, models without a TCXO oscillator will fall back to using any alternative external NTP time references that may be configured, changing stratum accordingly. If no alternative external NTP time references are configured, or if they fail, stratum 1 operation will cease after a further 9 hours and the device will enter an unsynchronised state.

NTP Peering

NTP can be configured to agree a common time between a number of NTP servers on a network. Peering allows a number of NTP servers to communicate together to provide a network with the same agreed time. Peering can be used to provide a high degree of redundancy.

Only servers with known good clocks should be peered together. The IP address or fully qualified domain name of peered NTP servers can be entered into the External Time Server field of the NTP Configuration Menu. See ‘Web Interface’ section.

External Backup NTP Servers

Many Internet based NTP servers will not allow peering. Therefore, if you want to configure an external NTP server that does not allow peering as a backup time reference, to be used in the event of failure of the primary reference, you will need to use the NTP ‘server’ command in the NTP configuration file. You can append commands to the NTP configuration file using the ‘Edit NTP Configuration’ option in the ‘NTP Configuration Menu’. The ‘server’ command has a single operand, the IP address or fully qualified domain name of the server to be used.

```
server time-b.nist.gov          # Domain name of external NTP time server
server 129.6.15.28              # IP address of external NTP time server
```

In the event of failure of the primary synchronisation reference, the backup server will be used for synchronisation. In this event the stratum of the NTP server will be one less than the stratum of the synchronisation server. ie. If the synchronisation server is stratum 2, the device will become stratum 3. The NTP server will only revert to stratum 1 operation when the primary synchronisation reference (GPS or LF radio) comes back on line.

Local Clock

The SR series has an internal battery-backed real-time clock (local clock) that NTP synchronises using the configured reference clocks. The local clock can also be used as an NTP reference clock itself, if other sources of time fail.

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The local system clock stratum specifies the stratum level of the local system clock that is used as backup in the event of primary reference clock loss or failure. Setting the local system clock stratum to 16 (default) disables this feature.
Warning – the local system clock is unsynchronised and is prone to drift. It should, therefore, only be used if synchronisation of clients to the NTP server is required regardless of the accuracy of the NTP server's time.

Typical Synchronisation Hierarchy

Higher Stratum	GPS LF radio TCXO (SR9750, SR9850, SC9705 models only) Other Peered Stratum 1 NTP Servers
	Lower Stratum External NTP Servers
Lower Stratum	Local Clock

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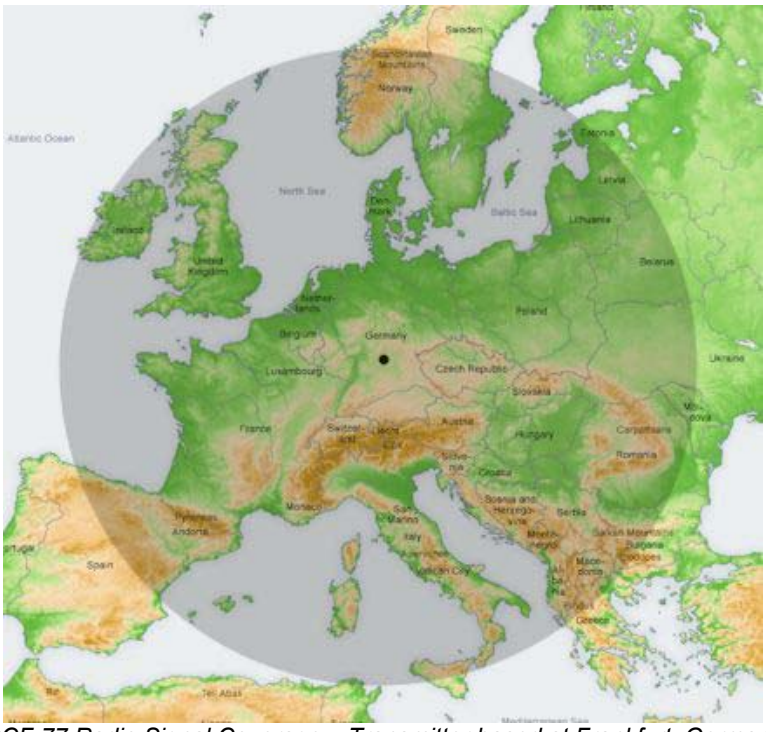
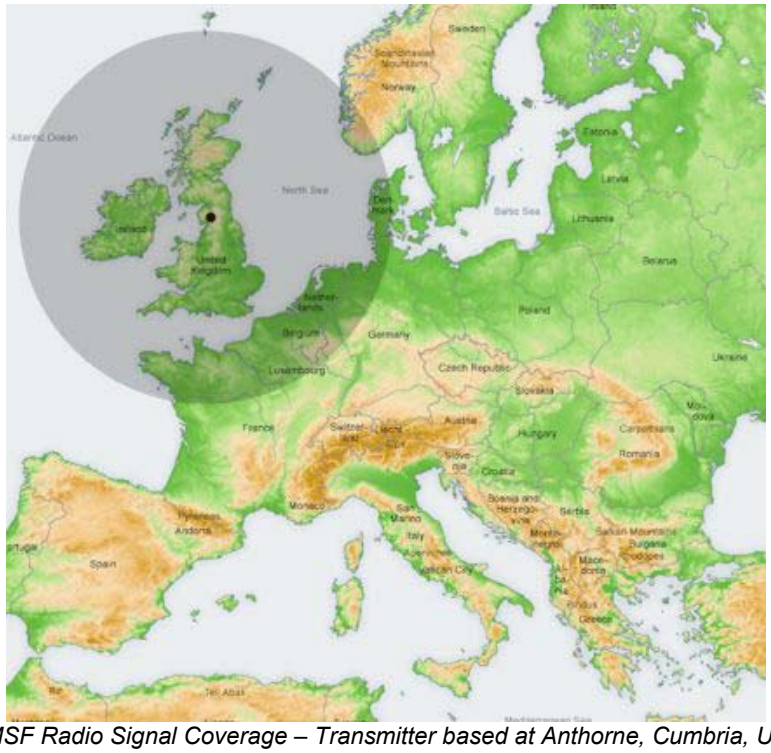
LF Radio Transmitter Coverage

The SR\SC Series NTP Server can be supplied with either DCF-77 or MSF radio antennas. The DCF-77 transmitter is located at Frankfurt, Germany. The coverage of the DCF-77 transmitter is Central and North-Western Europe.



DCF-77 Radio Signal Coverage – Transmitter based at Frankfurt, Germany

The MSF transmitter is located at Anthorn, Cumbria, UK. The coverage of the MSF transmitter is the whole of the British Isles and can often be received in much of North Western Europe.



MSF Radio Signal Coverage – Transmitter based at Anthorne, Cumbria, UK

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MSF \ DCF-77 Radio Antenna Installation

The SR\SC Series NTP Server can be supplied with either MSF or DCF-77 radio antennas.

LF Radio Antennas

Four versions of LF radio antenna are available with the SR Series NTP Server.

MLS - TimeTools Standard MSF radio antenna.
DLS - TimeTools Standard DCF-77 radio antenna.

MXS - TimeTools High Gain MSF radio antenna for weak signal strength areas.
DXS - TimeTools High Gain DCF-77 radio antenna for weak signal strength areas.

The antenna needs to be mounted above ground away from any sources of electrical interference. Metal structures can act as a Faraday cage blocking signal penetration. Therefore, the antenna must be located externally of any metal structures.

The SR series NTP server display provides a real-time signal strength indicator. This should read a steady 100%, any less indicates loss of timing information. Also displayed is the last decoded time reception, which should increment each minute as time broadcasts are received.

MLS \ DLS Antenna Installation

The MLS\DLS LF antenna is a unidirectional active ferrite antenna. The antenna should be installed in a horizontal plane at right angles to the source of the radio transmission. The antenna incorporates a red\green LED which flashes in tune to the LF radio transmission. Ideally, the antenna needs to be located where a consistent red\green flash can be observed once per second. If the antenna LED flashes erratically or if the LED is completely red or green, the antenna may need to be relocated.

The antenna can be located up to 100m from the time server using CAT3 or better patch lead or structured cabling.

Fig: MLS \ DLS LF Radio Antenna

MXS \ DXS Antenna Installation

The MXS\DXS LF antenna is a unidirectional high-gain active ferrite antenna ideal for low signal strength areas. The antenna should be installed in a horizontal plane at right angles to the source of the radio transmission. The antenna incorporates a red\green LED which flashes in tune to the LF radio transmission. Ideally, the antenna needs to be located where a consistent red\green flash can be observed once per second. If the antenna LED flashes erratically or if the LED is completely red or green, the antenna may need to be relocated.

The antenna is provided with 5m of cable which can be extended up to 100m using RG58 coax.

Fig: MXS \ DXS High Gain LF Radio Antenna

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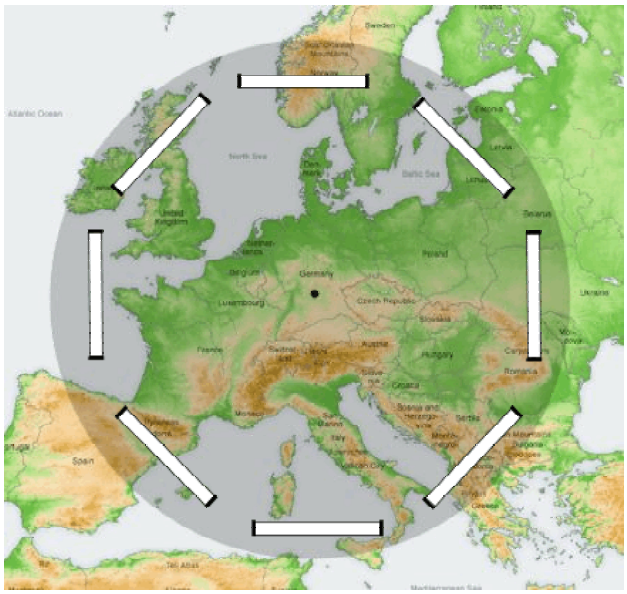
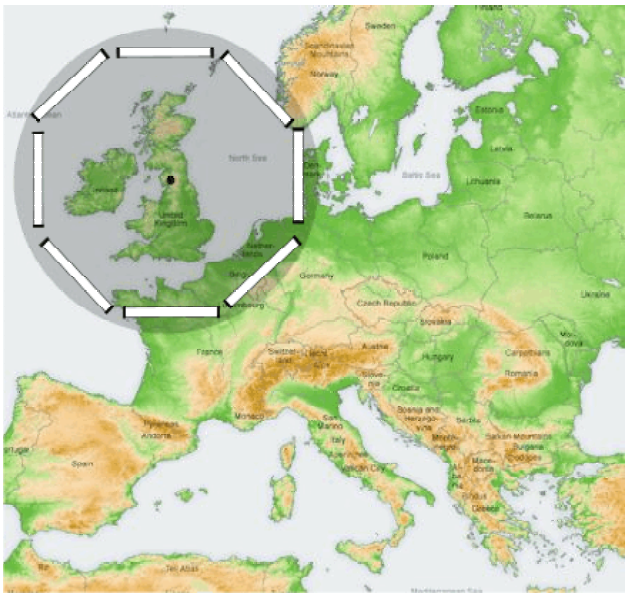


The DCF-77 LF radio antenna should be installed in a horizontal plane at right-angles to the source of the radio transmitter located at Frankfurt, Germany.



The MSF LF radio antenna should be installed in a horizontal plane at right-angles to the source of the radio transmitter located at Anthorne, Cumbria, UK.

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GPS Antenna Installation

The SR Series NTP Server has an integrated GPS receiver. An optional external antenna provides synchronisation with the global positioning system. GPS solutions can be utilised anywhere in the world.

The optional GPS antenna is a high-gain, jam-resistant, pole mounting GPS antenna,

For correct operation, the GPS antenna needs to have an un-obscured view of the sky. As a rule of thumb, the better the view of the sky, the more chance of a good consistent signal lock. Ideally, the antenna should be roof mounted with a 360-degree view of the sky. However, satisfactory operation can often be achieved by sitting the antenna on the side of a building or on a widow sill.

Typical Maximum GPS Cable Length (TWS3978 GPS Antenna)

Cable Type	Max Cable Distance
RG58	50m
LMR200	75m
LMR240	100m
LMR400	190m

SRxxxx-10 and SCxxxx-10 High Sensitivity GPS Receiver

Later SR and SC series NTP servers with model postfix 10 and later are fitted with a high sensitivity GPS receiver with over-determined clock. The high sensitivity mode often allows the GPS antenna to be located indoors or in a window, considerably reducing installation costs and eliminating the need for surge suppression. The over-determined clock mode allows the receiver to operate from a single-satellite-in-view which allows the receiver to obtain a signal lock in highly challenging conditions.

In high sensitivity mode if the initial search for satellites fails to find a strong GPS signal, the receiver enters deep search mode and the time-to-first fix may take longer than normal. If during this period, the receiver is moved into bright signal conditions, the time-to-first fix may also take longer.

GPS Amplifier

Single or multiple GPS in line amplifiers may be installed to significantly increase cable runs, if required (product code: T-AD200-8). GPS amplifiers should be placed in-line on the coax cable at the mid-point between the GPS antenna and receiver.

Surge Suppressors

Externally mounted GPS antennas can be prone to lightning strikes and other electrical surges. TimeTools recommends fitting surge suppressors (product code: SPP-GPS) to all externally mounted GPS antennas. The suppressor should be fitted where the GPS coax cable from the antenna enters the building. The surge suppressor requires a connection to a low-impedance ground. For more information about installing surge suppressors please visit the PolyPhaser web site at: www.polyphaser.com.

GPS Time Acquisition

On power-up the GPS receiver will “search the sky” in order to collect satellite orbital information. This process is fully automatic and, under normal circumstances, will take 3-4 minutes to achieve a signal lock. However, it can take much longer in challenging reception areas.

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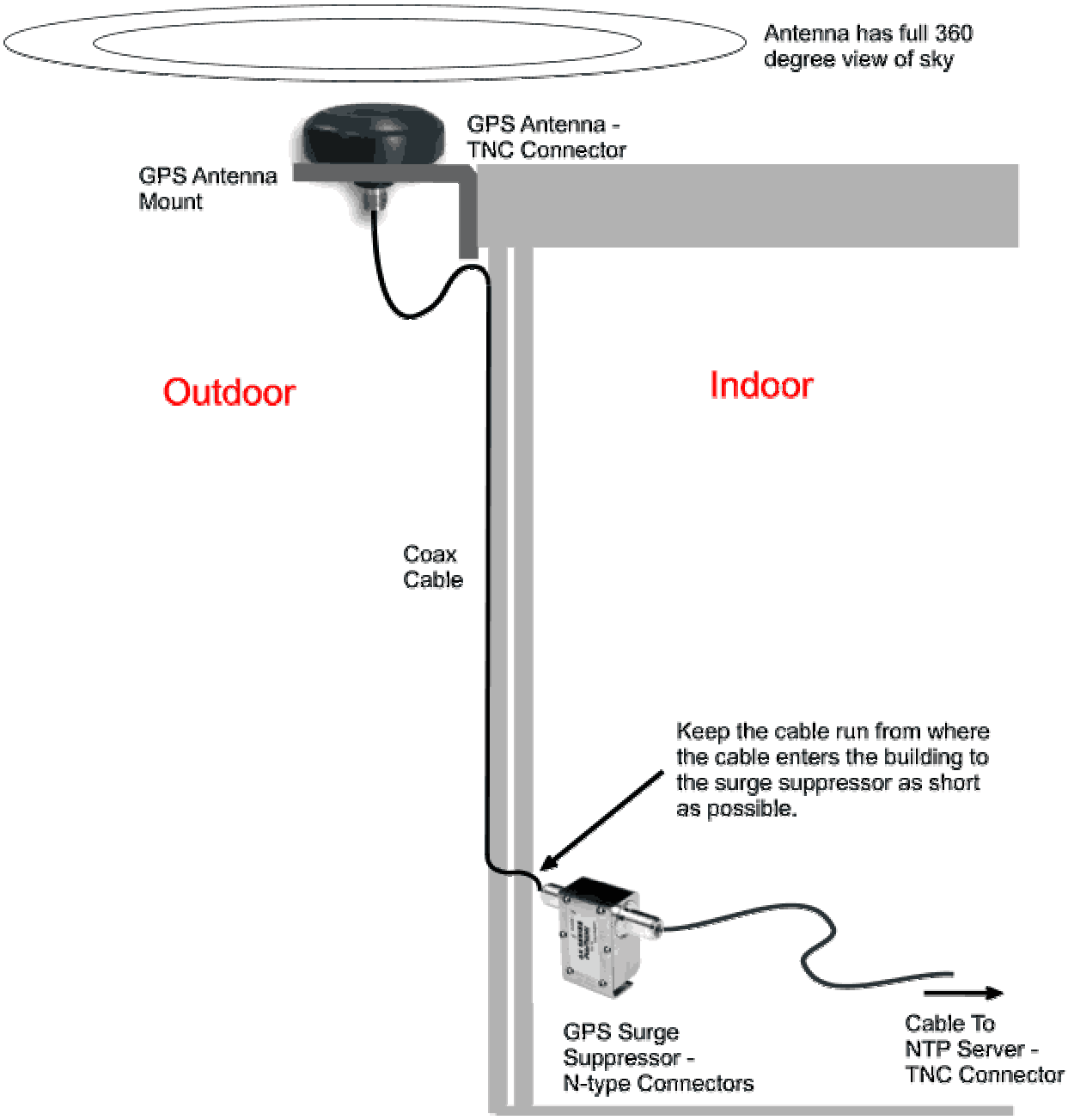
Antenna has full 360 degree view of sky
GPS Antenna - TNC Connector
GPS Antenna Mount
Outdoor
Indoor
Coax Cable
Keep the cable run from where the cable enters the building to the surge suppressor as short as possible.
GPS Surge Suppressor - N-type Connectors
Cable To NTP Server - TNC Connector

Typical GPS Antenna installation

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SR Series Configuration

The SR Series can be configured in a number of ways:

- Web (HTTP) page via network.
- Via RS232 Console Port to host computer.
- Telnet session via network.
- Secure Web (HTTPS) page via network (SR9xxx\SC9xxx only).
- Secure SSH (SR9xxx\SC9xxx only).

Default Configuration

Security

Console, Telnet, FTP username	admin
Console, Telnet, FTP password	admin
HTTP Web Password	admin

Network Configuration

Host Name	NTP001
Domain Name	-
Name Server 1	-
Name Server 2	-
Syslog Server	-
Network Services	HTTP: Enabled, HTTPS: Disabled, Telnet: Enabled, SSH: Disabled, FTP: Enabled.
DHCP	Enabled
IP Address	-
Network Mask	-
Default Gateway	-

NTP Configuration

External NTP Server Address 1	-
Key	-
External NTP Server Address 2	-
Key	-
External NTP Server Address 3	-
Key	-
NTP Broadcast Address	-
Key	-
Local System Clock Stratum	16
Trusted Keys	-
NTP Keys	-

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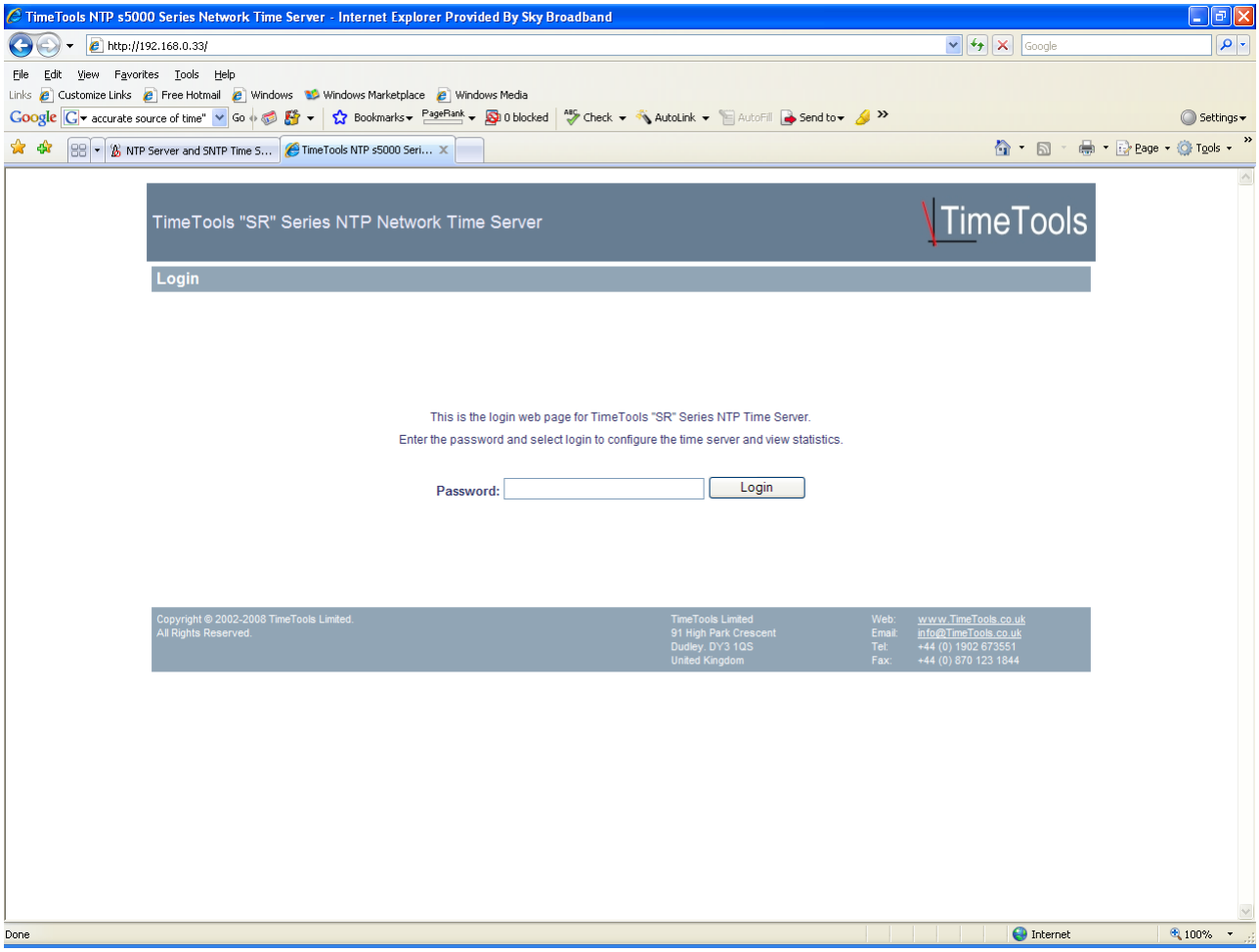
Web Interface

The web interface can be initiated by entering the IP address of the time server into a web browser, such as Internet Explorer, eg http://192.168.0.4. The user will then be greeted by the login screen. A secure web connection (HTTPS) can also be used, if the HTTPS protocol is enabled (SR9xxx,SC9xxxx models only).


TimeTools NTP s5000 Series Network Time Server - Internet Explorer Provided By Sky Broadband
http://192.168.0.33/
TimeTools "SR" Series NTP Network Time Server
TimeTools
Login
This is the login web page for TimeTools "SR" Series NTP Time Server.
Enter the password and select login to configure the time server and view statistics.
Password:
Login
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United Kingdom
Web: www.TimeTools.co.uk
Email: info@TimeTools.co.uk
Tel: +44 (0) 1902 673551
Fax: +44 (0) 870 123 1844
Done
Internet
100%

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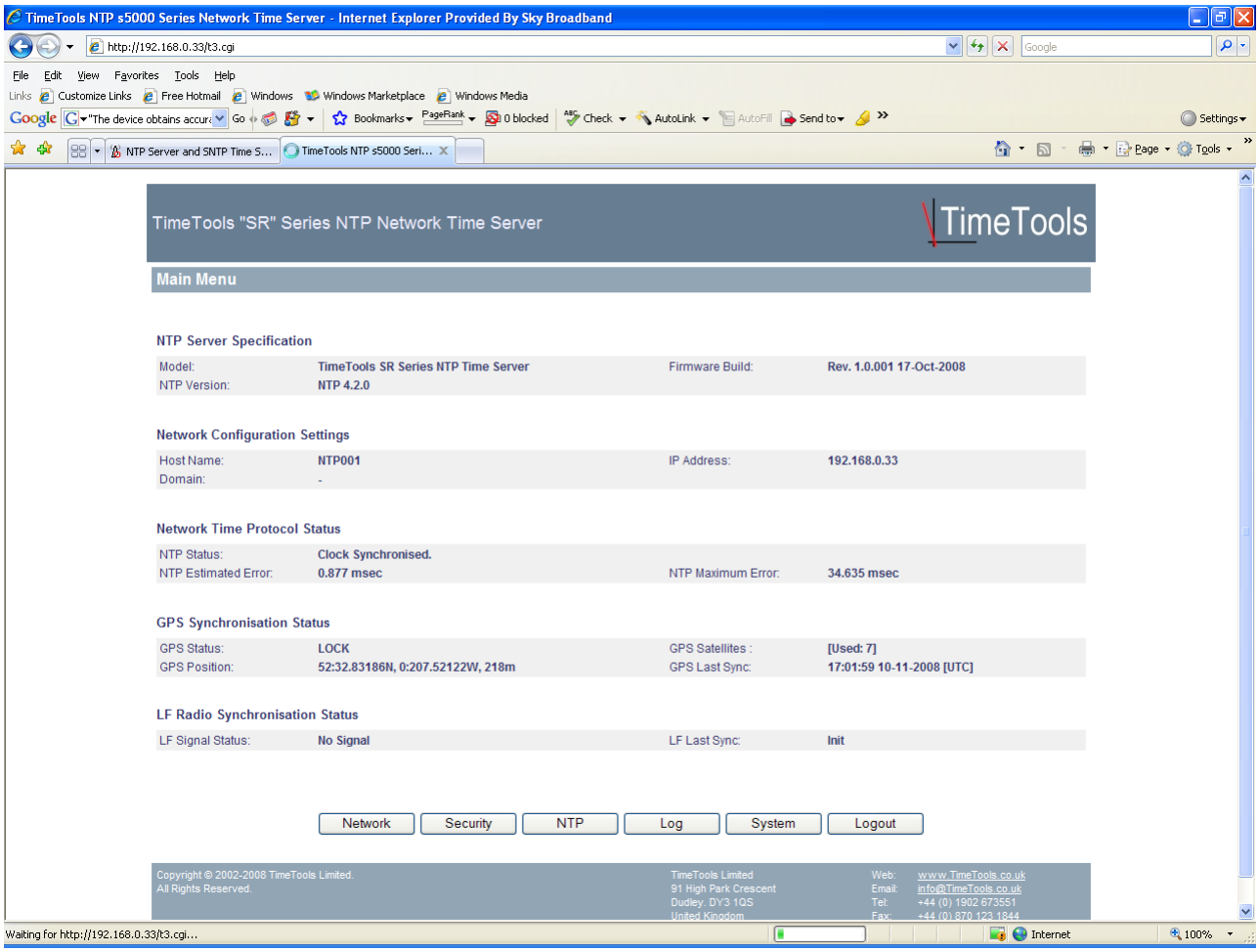
Configuration Menu



Model	NTP Server model.
Build	Describes the firmware build revision number and firmware build date.
NTP Version	Network Time Protocol version number currently installed.
Hostname	Hostname of time server.
Domain	Network domain name
IP Address	Network IP address of time server.
NTP Status	Clock Synchronised / Clock Not Synchronised
NTP Estimated Error	Estimated kernel time error
NTP Maximum Error	Maximum kernel time error
GPS Status	Lock: GPS satellite lock has been achieved and receiver operation OK. No Lock: GPS satellite lock not acheived or lost. This may be due to poor antenna location. No Comm: Indicates no communication with GPS receiver, probable receiver fault
GPS Postion	GPS positioning information, location and height
GPS Satellites	Satellites used in last timing calculation and visible satellites
LF Signal Status	MSF \ DCF-77 radio antenna (if fitted) signal strength indicator (0%-100%). For good signal reception and decoding a consistant 100% signal strength is required of an extended period of

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	time. NOSIG Indicates either no radio antenna detected, antenna fault or complete lack of signal reception
LF Last Sync	Last Sync Shows the last successfully decoded time from the MSF \ DCF-77 (if fitted) radio antenna. A radio time stamp is broadcast once every minute.

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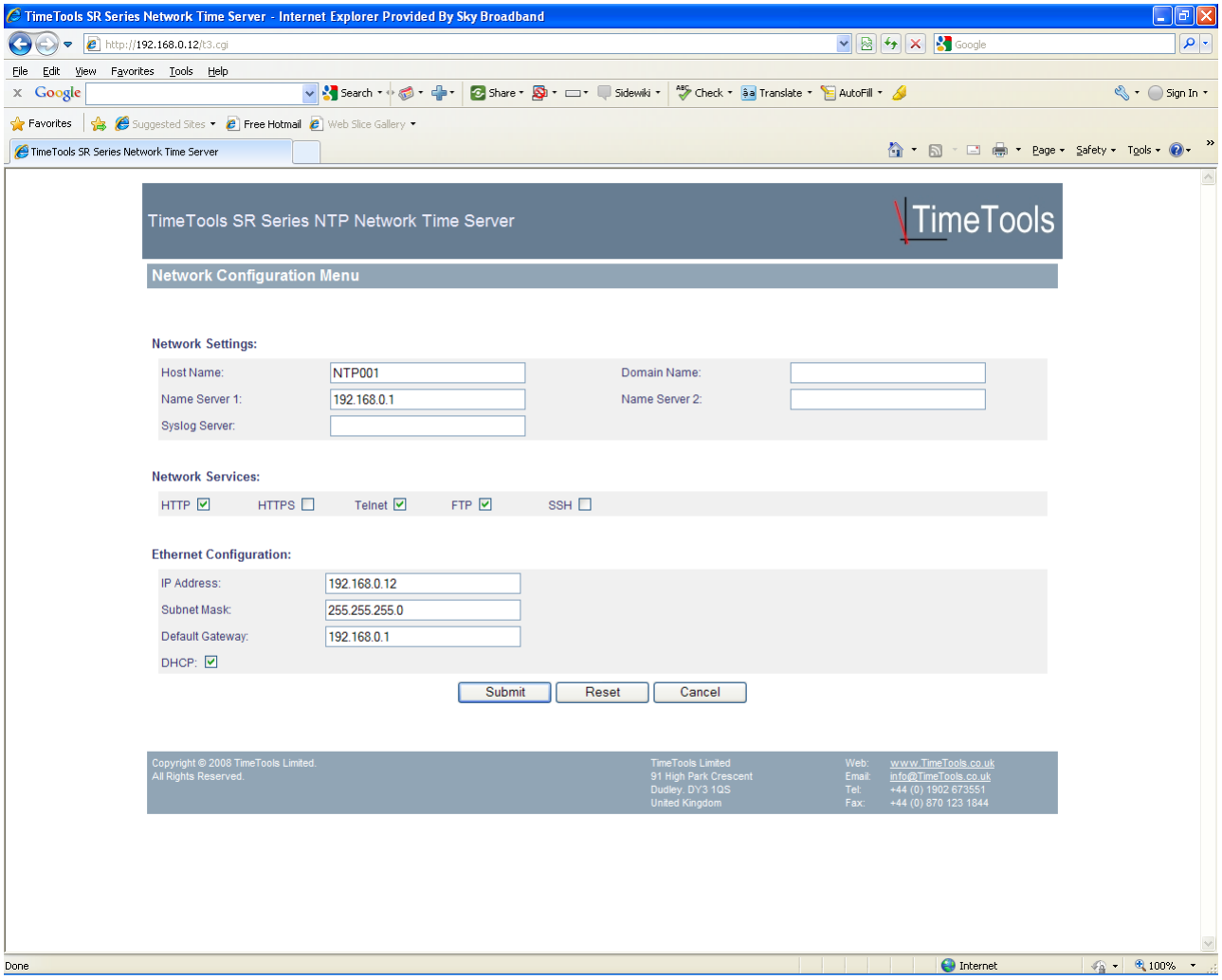
Network Configuration Menu



Hostname	Hostname of time server.
Domain	Network domain name
Name Server 1	IP address of DNS name server 1.
Name Server 2	IP address of DNS name server 2.
Syslog Server 1	Optional IP address for remote system log (syslog) messages
Network Services	Shows which network services are currently enabled. For added security any or all network services can be disabled. (HTTPS and SSH are only available on SR9xxx\SC9xxxx models)
IP Address	Network IP Address of the time server
Subnet Mask	Network mask
Default Gateway	Network default gateway
DHCP	Enable Dynamic Host Configuration Protocol

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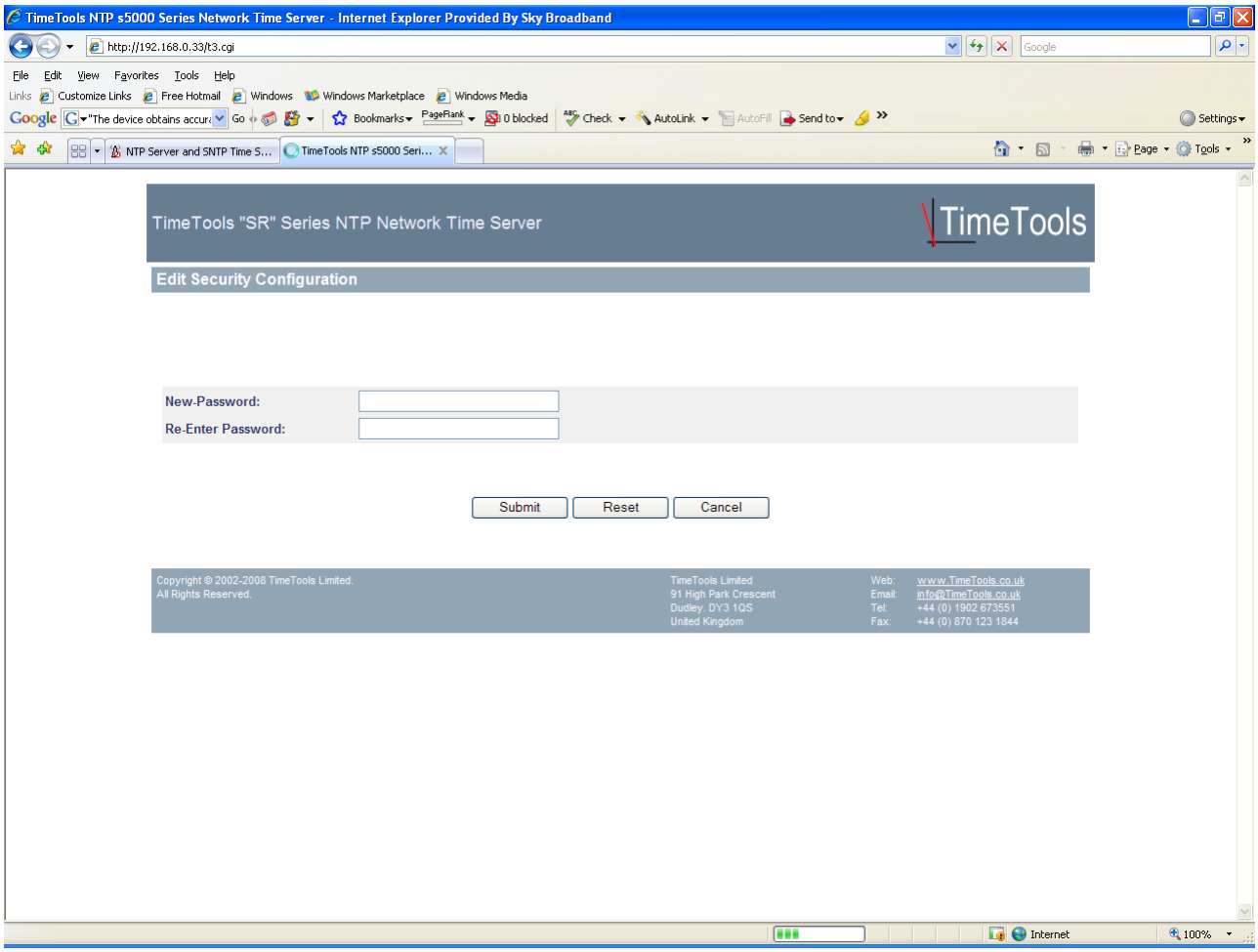
Security Configuration



Change Password Change ‘admin’ password for console and telnet connection.

A separate password exists for http (web interface) sessions. The http (web interface) password can only be changed from the web interface.

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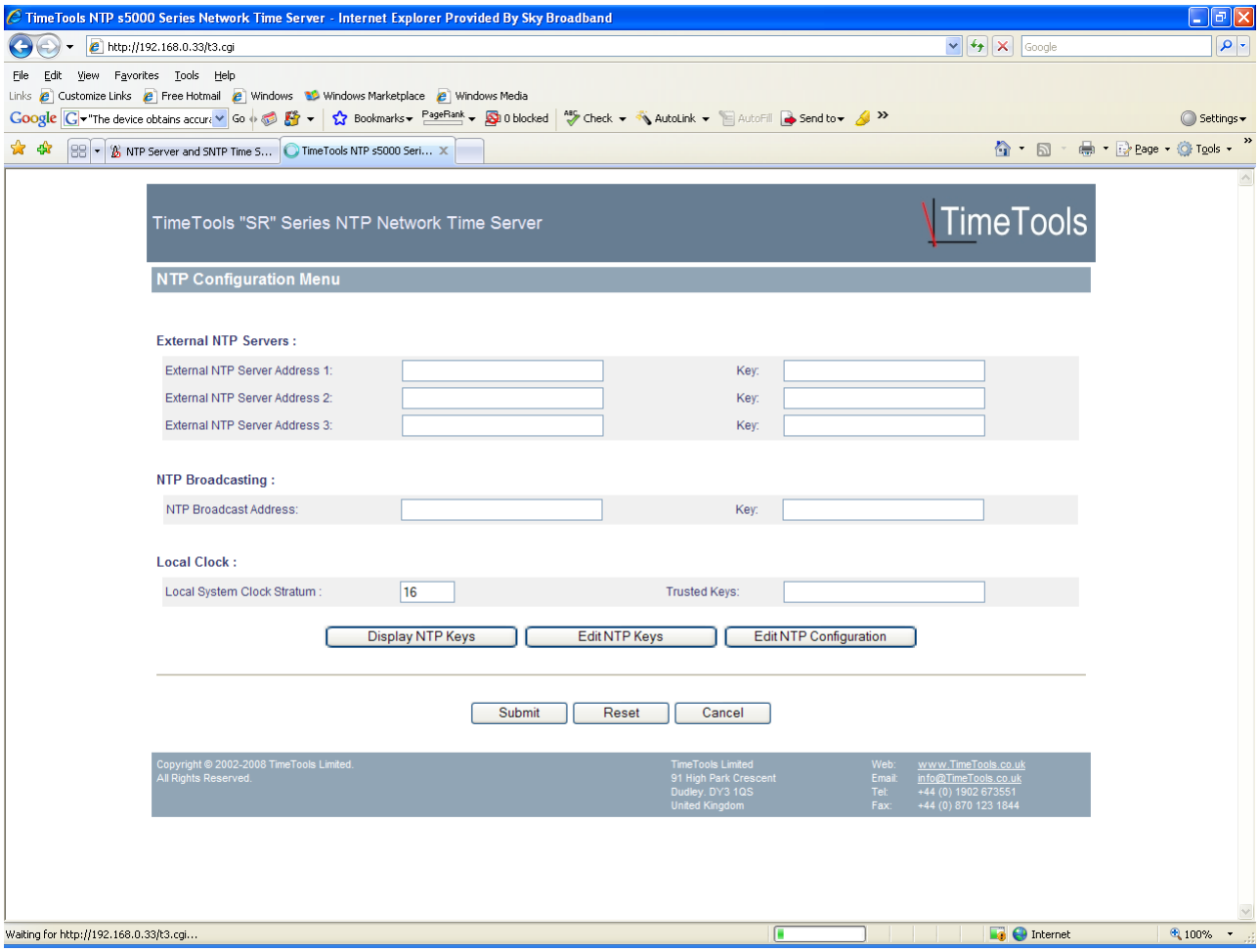
NTP Configuration Menu



External NTP Servers	Upto three external NTP servers can be peered with the time server to provide backup in the event of primary time source loss or failure. In this mode the local clock can be synchronized to the remote peer or the remote peer can be synchronized to the local clock. This is useful in a network of servers where, depending on various failure scenarios, either the local or remote peer may be the better source of time.
NTP Broadcasting	In broadcast mode the local server sends periodic broadcast messages to a client population at the *address* specified, which is usually the broadcast address on (one of) the local network(s) or a multicast address assigned to NTP. The IANA has assigned the multicast group address IPv4 224.0.1.1 and IPv6 ff05::101 (site local) exclusively to NTP, but other nonconflicting addresses can be used to contain the messages within administrative boundaries. Ordinarily, this specification applies only to the local server operating as a sender; for operation as a broadcast client
Local System Clock Stratum	The local system clock stratum specifies the stratum level of the local system clock that is used as backup in the event of primary reference clock loss or failure. Setting the local system clock stratum to 16 (default) disables this feature. Warning – the local system clock is unsynchronised and is prone to drift. It should, therefore, only be used if synchronisation of clients to the NTP server is required regardless of the accuracy of the NTP server's time.

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Trusted Keys	Specifies the key identifiers, which are trusted for the purposes of authenticating peers with symmetric key cryptography, as well as keys used by the `ntpq` and `ntpdc` programs. The authentication procedures require that both the local and remote servers share the same key and key identifier for this purpose, although different keys can be used with different servers. The *`key`* arguments are 32-bit unsigned integers with values from 1 to 65,534.
NTP Keys	Contains key identifiers and keys controlling authentication of Network Time Protocol (NTP) transactions.

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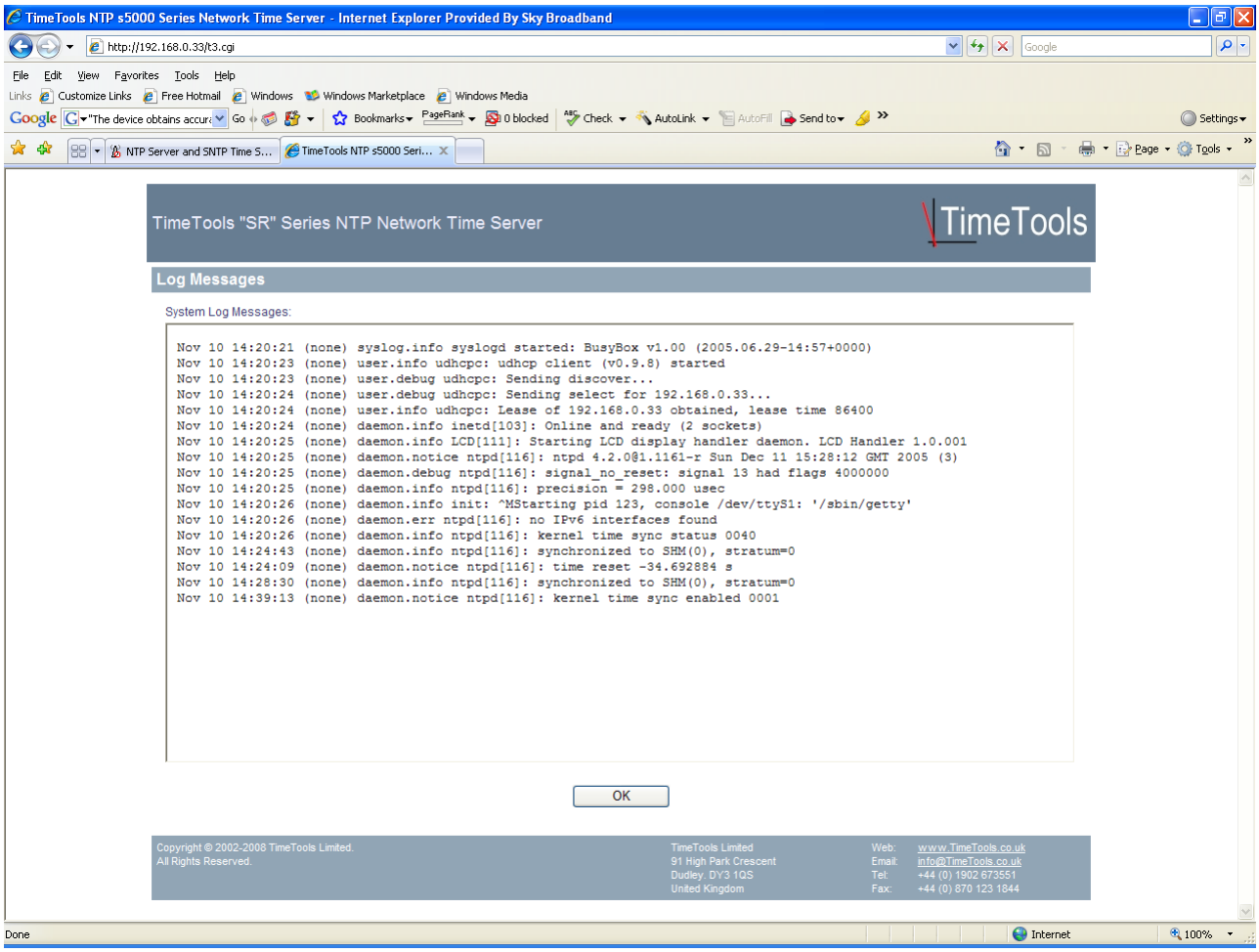
Log Messages


TimeTools NTP s5000 Series Network Time Server - Internet Explorer Provided By Sky Broadband
http://192.168.0.33/t3.cgi
TimeTools "SR" Series NTP Network Time Server
TimeTools
Log Messages
System Log Messages:
Nov 10 14:20:21 (none) syslog.info syslogd started: BusyBox v1.00 (2005.06.29-14:57+0000)
Nov 10 14:20:23 (none) user.info udhcpc: udhcp client (v0.9.8) started
Nov 10 14:20:23 (none) user.debug udhcpc: Sending discover...
Nov 10 14:20:24 (none) user.debug udhcpc: Sending select for 192.168.0.33...
Nov 10 14:20:24 (none) user.info udhcpc: Lease of 192.168.0.33 obtained, lease time 86400
Nov 10 14:20:24 (none) daemon.info inetd[103]: Online and ready (2 sockets)
Nov 10 14:20:25 (none) daemon.info LCD[111]: Starting LCD display handler daemon. LCD Handler 1.0.001
Nov 10 14:20:25 (none) daemon.notice ntpd[116]: ntpd 4.2.0@1.1161-r Sun Dec 11 15:28:12 GMT 2005 (3)
Nov 10 14:20:25 (none) daemon.debug ntpd[116]: signal_no_reset: signal 13 had flags 4000000
Nov 10 14:20:25 (none) daemon.info ntpd[116]: precision = 298.000 usec
Nov 10 14:20:26 (none) daemon.info init: ^MStarting pid 123, console /dev/ttyS1: '/sbin/getty'
Nov 10 14:20:26 (none) daemon.err ntpd[116]: no IPv6 interfaces found
Nov 10 14:20:26 (none) daemon.info ntpd[116]: kernel time sync status 0040
Nov 10 14:24:43 (none) daemon.info ntpd[116]: synchronized to SHM(0), stratum=0
Nov 10 14:24:09 (none) daemon.notice ntpd[116]: time reset -34.692884 s
Nov 10 14:28:30 (none) daemon.info ntpd[116]: synchronized to SHM(0), stratum=0
Nov 10 14:39:13 (none) daemon.notice ntpd[116]: kernel time sync enabled 0001
OK
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TimeTools Limited
91 High Park Crescent
Dudley. DY3 1QS
United Kingdom
Web: www.TimeTools.co.uk
Email: info@TimeTools.co.uk
Tel: +44 (0) 1902 673551
Fax: +44 (0) 870 123 1844
Done
Internet
100%

The log messages window displays the current contents of the system log. This includes all NTP information and error messages.

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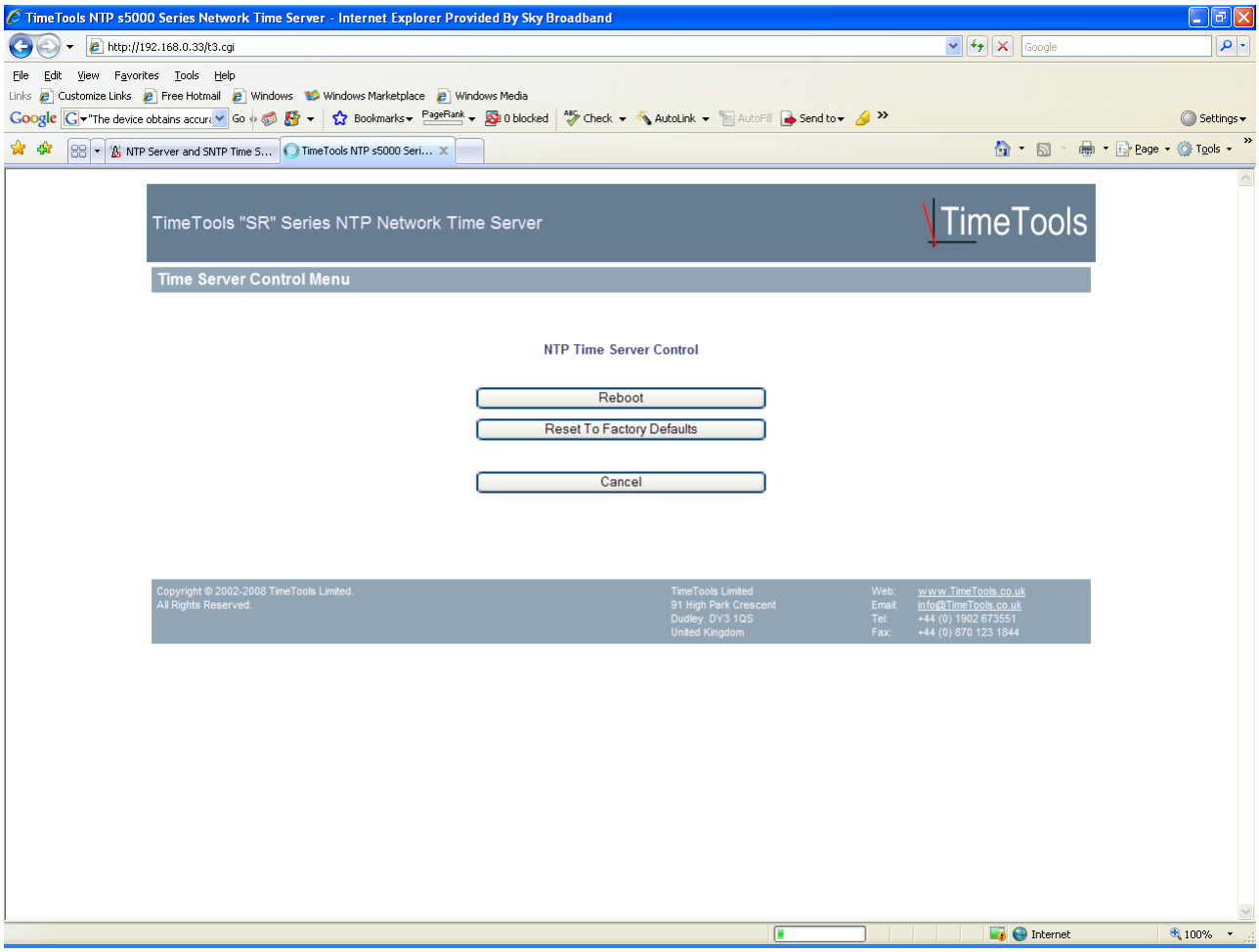
Time Server Control Menu



Reboot	The reboot option restarts the time server. It is used to make any network configuration changes active.
Factory Defaults	The factory defaults menu option reverts all settings back to the factory defaults. However, the console and telnet ‘admin’ passwords are not changed.

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Uploading User Generated SSL Certificates

The SR9xxx and SC9xxx models can accept a user generated SSL certificate for authentication. The user generated certificate must be uploaded into the SR series '/tmp/admin' directory using ftp. The uploaded certificate then needs to be saved into flash using the 'certsave' command available from a console session to the time server.

Savecert syntax:

savecert - save SSL certificate to flash.

usage: savecert <filename>	- save user certificate <filename> to flash.
savecert -remove	- remove user certificate from flash and use default certificate.

The device will need to be restarted for the changes to take effect.

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Console Configuration

RS232 Console Configuration

Use the console configuration cable provided to connect the ‘console’ port of the SR Series to a serial port of a computer.

A dumb terminal emulator, such as Hyper Terminal, can then be used on the computer to access the configuration menu of the NTP server.

Dumb Terminal Configuration Settings

Connect Using:	Direct to COMx	(where x is the com port number)
Bits per second:	9600	
Data bits:	8	
Parity:	None	
Stop bits:	1	
Flow control:	None	
Terminal Emulation:	ANSI	

Once the dumb terminal has been configured and the console cable connected to the correct COM port, the login prompt will appear by pressing ‘ENTER’.

Telnet Session via Remote Host

The time server can be configured remotely using a telnet session configured for VT100 emulation. From a host computer type:

```
telnet –t vt100 xxx.xxx.xxx.xxx
```

where xxx.xxx.xxx.xxx is the IP address of the time server. On successful connection, the login prompt will appear.

Secure Telnet Session (SSH) via Remote Host

The time server can be configured remotely using a secure telnet session (SSH), if enabled, configured for VT100 emulation (SR9xxx and SC9xxx models only).

Logging On

The default username and password is ‘admin’.

```
Linux 2.4.31 (NTP001) (0)

NTP001 login: admin
Password:
```

The console configuration menu can be entered by typing ‘console’ at the prompt:

```
/tmp/admin $console
```

The console application provides an easy to use configuration and status tool that is similar in format to the web interface menus.

If the SR series detects no key-presses over a period of 5 minutes, then the console configuration menu will automatically exit.

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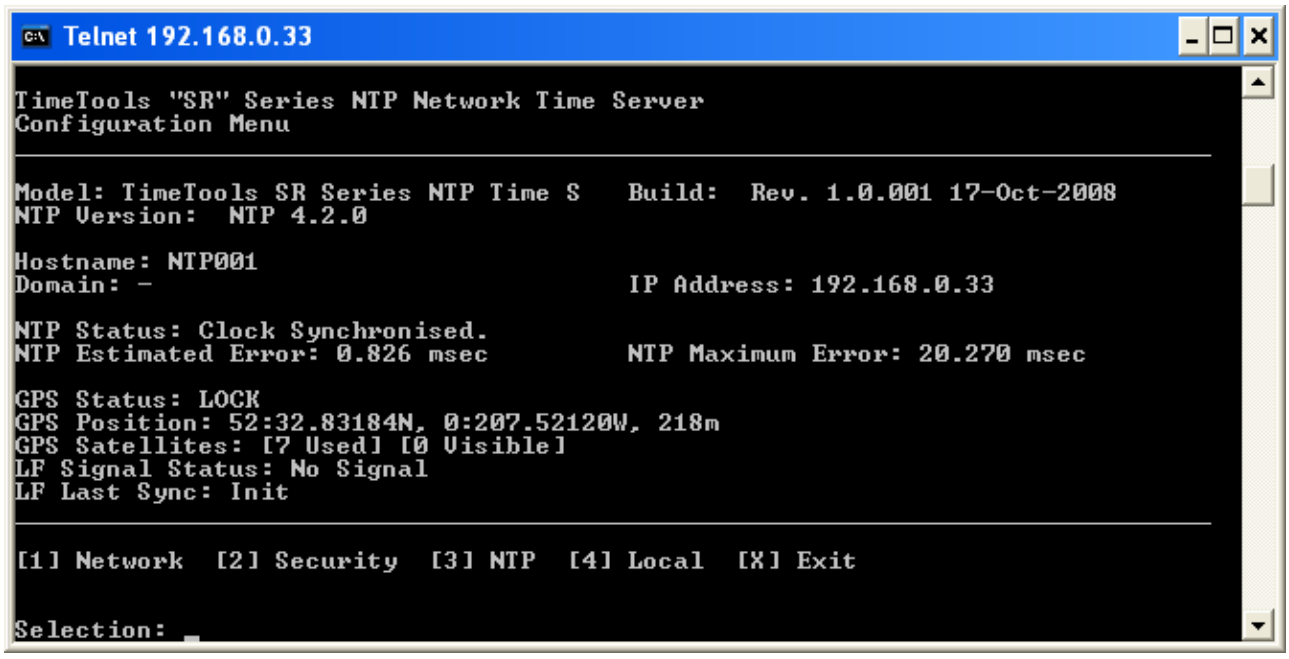
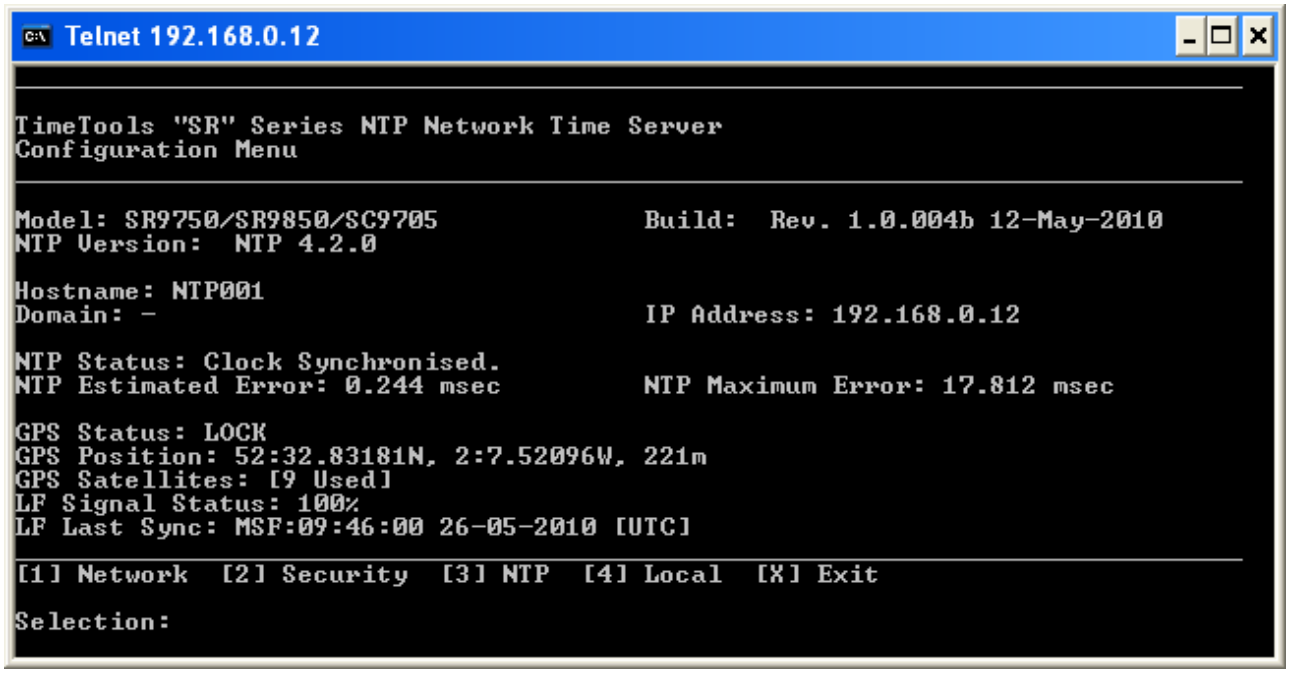
Configuration Menu


Telnet 192.168.0.33
TimeTools "SR" Series NTP Network Time Server
Configuration Menu
Model: TimeTools SR Series NTP Time S
Build: Rev. 1.0.001 17-Oct-2008
NTP Version: NTP 4.2.0
Hostname: NTP001
Domain: -
IP Address: 192.168.0.33
NTP Status: Clock Synchronised.
NTP Estimated Error: 0.826 msec
NTP Maximum Error: 20.270 msec
GPS Status: LOCK
GPS Position: 52:32.83184N, 0:207.52120W, 218m
GPS Satellites: [7 Used] [0 Visible]
LF Signal Status: No Signal
LF Last Sync: Init
[1] Network [2] Security [3] NTP [4] Local [X] Exit
Selection:

The configuration menu provides network, NTP and reference clock status information.

Network Configuration Menu



The network configuration menu displays the time server network configuration and allows settings to be modified. In order for any network changes to take effect, the time server should be rebooted.

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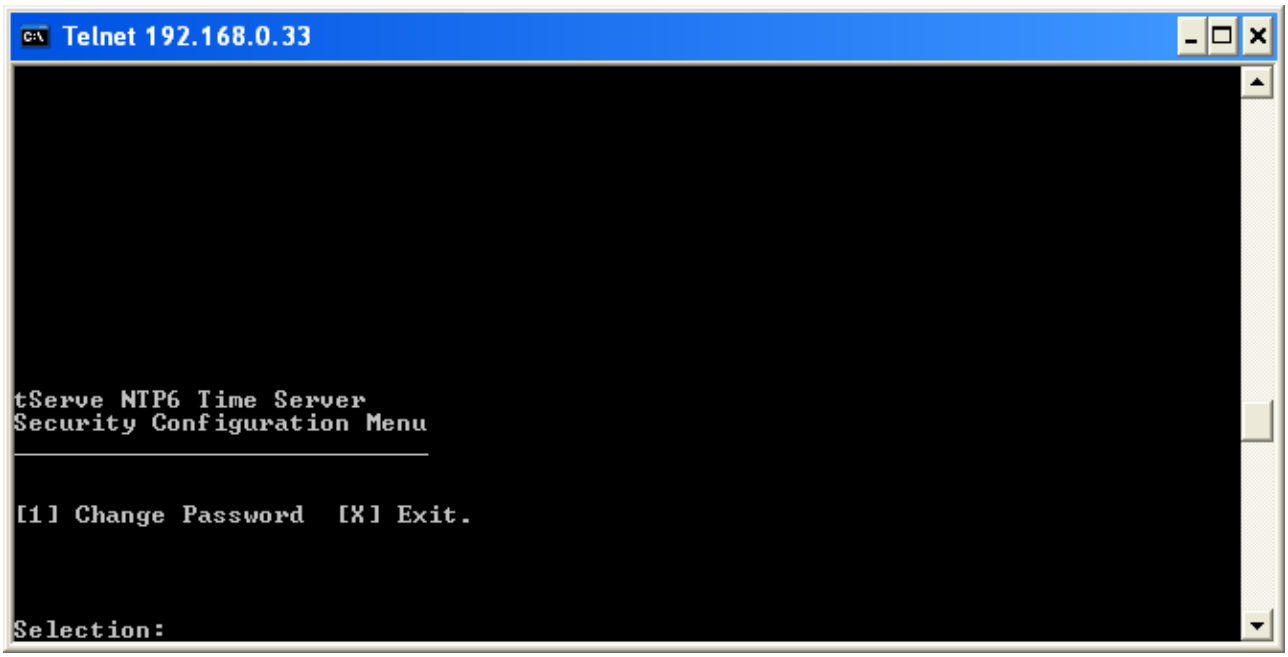
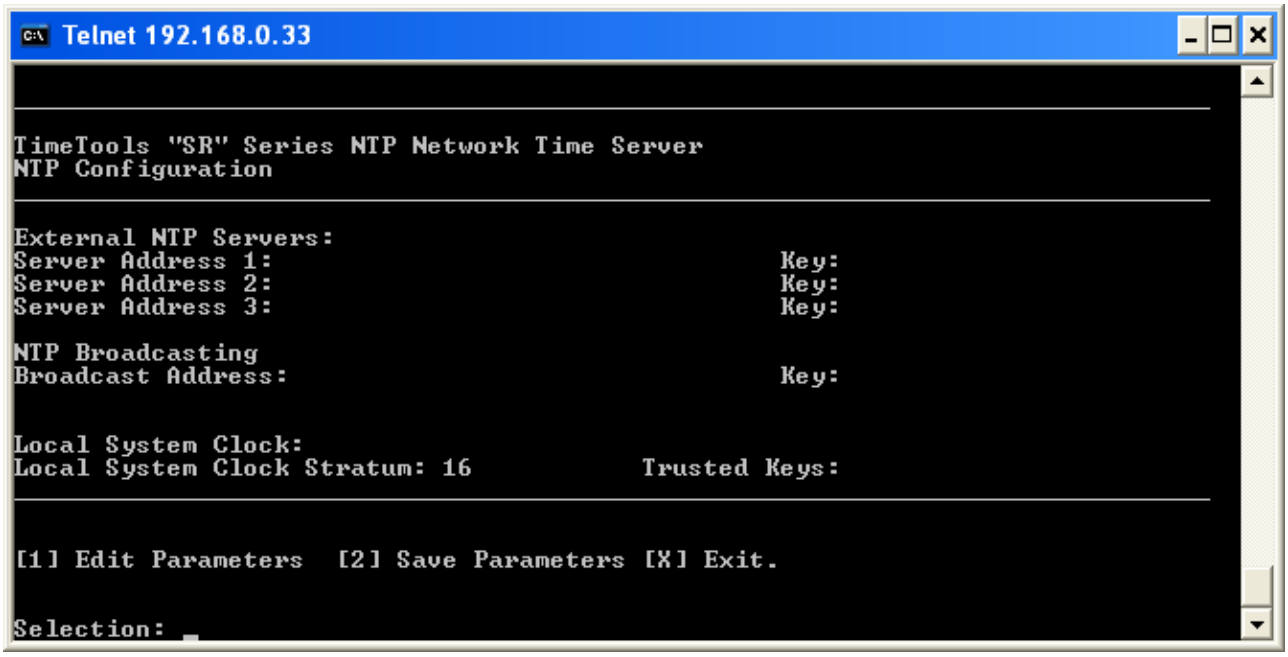
Security Configuration Menu



Change Password - Change 'admin' password for console and telnet connection.

A separate password exists for http (web interface) sessions. The http (web interface) password can only be changed from the web interface.

NTP Configuration



Display and edit NTP configuration parameters.

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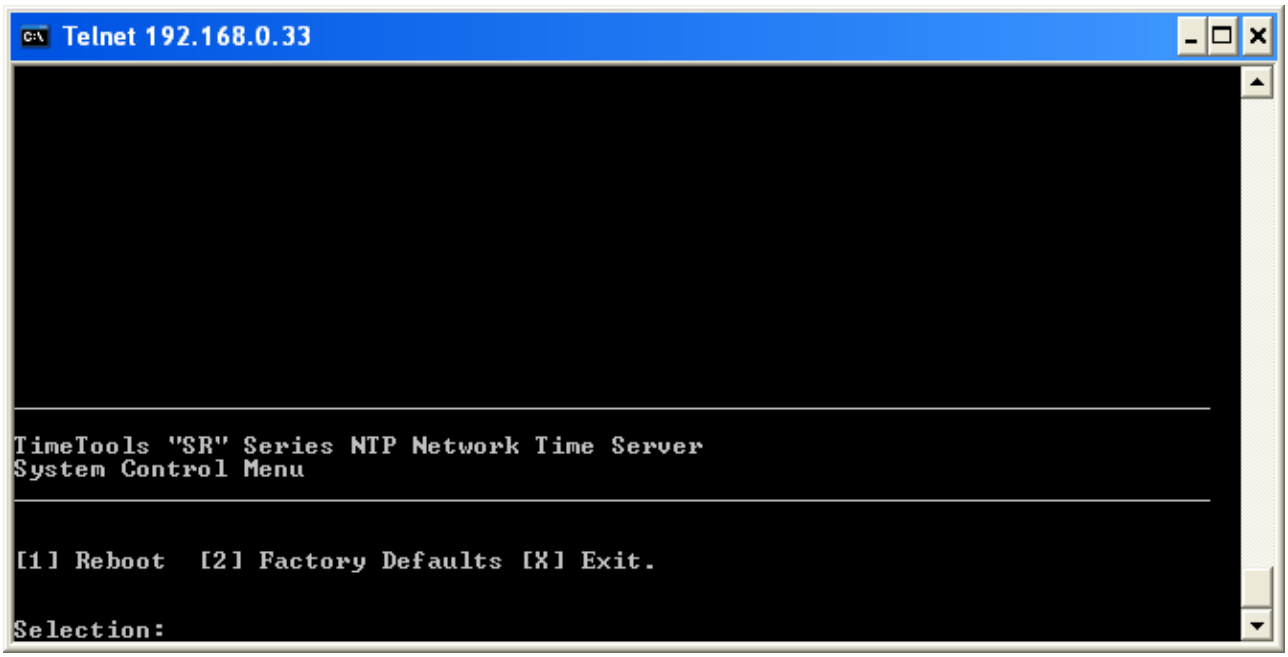
System Control Menu


Telnet 192.168.0.33
TimeTools "SR" Series NTP Network Time Server
System Control Menu
[1] Reboot [2] Factory Defaults [X] Exit.
Selection:

Allow time server to be rebooted and revert to factory settings.

In order for any network changes to take effect, the time-server should be rebooted.

Reverting to factory defaults does not affect the ‘console’ password. However the http web password reverts to ‘admin’.

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System Log (SysLog) Messages

System log messages are generated by both the NTP daemon and the reference clock daemon to warn of a system status change. Log messages can be viewed from the /tmp/admin folder using ftp, the log tab of the system web page or by remote syslog messaging.

The following messages are generated by the LF/GPS/TCXO reference clock daemon:

Type	Log Message	Model	Description
Error	ERROR: GPS communications timedout.	All Models (GPS)	Communications error with GPS receiver – possible hardware fault.
Warning	No GPS signal lock.	All Models (GPS)	GPS signal lock lost – possibly due to poor antenna location or faulty GPS antenna / cable.
Warning	LF radio reception timedout.	All Models (LF)	No valid radio timestamp received during last 3 minutes – possibly due to poor radio antenna location or faulty antenna / cable.
Warning (Debug)	Warning: TCXO oscillator calibration after %f secs outside expected range. (%f - %f) / %f = %f secs	SR9750/9850/SC9705	Invalid TCXO calibration to GPS/LF radio references – possible hardware fault.
Warning	Oscillator freerun period end	SR9750/9850/SC9705	The 24-hour TCXO oscillator stratum -1 holdover free-run period has come to an end.
Information	TimeTools Dual GPS\LF NTP Reference Clock Driver Started.	All Models	Reference clock driver startup message.
Information	GPS signal lock OK.	All Models (GPS)	GPS signal lock regained after loss of signal.
Information	LF radio reception OK.	All Models (LF)	LF radio reception resumed after loss of signal.
Information	Holdover oscillator calibrated.	SR9750/9850/SC9705	TCXO holdover oscillator calibrated to GPS / LF radio and is ready to run, if required.
Information	Oscillator freerun start.	SR9750/9850/SC9705	TCXO oscillator starting free-run stratum-1 holdover – due to loss of GPS / radio reference clock signal.

The following messages are generated by the NTP daemon – all models:

Type	Log Message	Description
Information	precision = 306.000 usec	Estimated system precision.
Information	kernel time sync status 0040	Clock unsynchronised
Notice	kernel time sync disabled 0001	NTP clock unsynchronised.
Notice	kernel time sync enabled 0001	NTP clock synchronised.
Information	synchronized to SHM(0), stratum=0	NTP currently synchronised to GPS reference clock.
Information	synchronized to SHM(1), stratum=0	NTP currently synchronised to LF radio reference clock.
Error	no servers reachable	All specified reference clocks are un-contactable.
Information	time reset ? s	On initial synchronisation, the system time has been adjusted to the correct time.

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Updating SR Series Firmware

Updating the SR series NTP Server firmware is very straightforward.

1. Obtain Firmware Upgrade

Firmware upgrades can be obtained from http://www.timetools.co.uk/support/.

The firmware upgrade is stored as a compressed tarball that must be uploaded to the time server and unpacked. This is a very simple exercise.

IMPORTANT: Ensure firmware upgrade matches model type of installation unit.
Eg. SR71-x.x.xxx.tgz for TimeTools SR7110 and SC7105 series NTP server models.
SR92-x.x.xxx.tgz for TimeTools SR9210 and SC9205 series NTP server models.
SR97-x.x.xxx.tgz for TimeTools SR9750, SR9850 and SC9705 series NTP server models.

2. Uploading Firmware Using Ftp.

To upload the firmware upgrade to the unit requires the use of an FTP Client such as WS_FTP available from http://www.ipswitch.com/products/file-transfer.asp.

Typical FTP Settings:

Host: **192.168.0.200 (IP address of time server)**
Port: **21 (standard FTP port)**
Host Type: **UNIX (standard)**
User ID: **admin**
Password: **admin**

Change directory to '/tmp/admin'

Upload the firmware upgrade tarball file, **'SRmm-x.x.xxx.tgz'** to /tmp/admin directory.

3. Installing Firmware

From a telnet session, login as 'admin', password 'admin' (unless password modified).

```
>telnet 192.168.0.200
>NTP001 Login: admin
>Password: admin
```

Extract firmware as follows:

```
>extract SRmm-x.x.xxx.tgz          #Execute extract script, where SRmm-x.x.xxx.tgz is the update file.
WARNING: DO NOT TURN OFF OR RESET DEVICE UNTIL UPGRADE COMPLETE !
Update complete.
```

Finally, reboot the time server for the firmware upgrade to take effect.

```
>restart
```

4. Checking New Version Number.

When the unit has restarted, use a web-browser to check that the firmware version number has been updated. The unit has now been successfully updated.

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NTP Authentication

Symmetric Key Cryptography

The original RFC-1305 specification allows any one of possibly 65,534 keys, each distinguished by a 32-bit key identifier, to authenticate an association. The servers and clients involved must agree on the key and key identifier to authenticate NTP packets.

Keys and related information are specified in a key file. Besides the keys used for ordinary NTP associations, additional keys can be used as passwords for the `ntpq` and `ntpdc` utility programs.

When `ntpd` is first started, it reads the key file and installs the keys in the key cache. However, individual keys must be activated with the `trusted keys` command before use. This allows, for instance, the installation of possibly several batches of keys and then activating or deactivating each batch remotely using `ntpdc`. This also provides a revocation capability that can be used if a key becomes compromised.

NTP Keys

NTP Keys are entered in the following format:

KeyNumber **M** Key

where,

KeyNumber	A positive integer (1 to 65,534)
M	Specifies that Key is a 1-to-8 character ASCII string, using the MD5 authentication scheme.
Key	The key itself.

Trusted Keys

The trusted keys specifies the key identifiers which are trusted for the purposes of authenticating peers with symmetric key cryptography, as well as keys used by the ntpq and ntpdc programs. The authentication procedures require that both the local and remote servers share the same key and key identifier for this purpose, although different keys can be used with different servers. The *key* arguments are 32-bit unsigned integers with values from 1 to 65,534.

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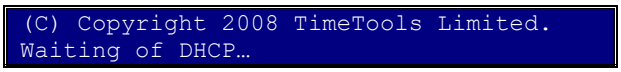
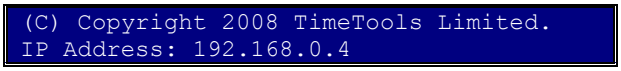
SR Series NTP Server Operation – LCD Display

LCD Display – Initial Power-Up

On power-up the SR Series LCD display will remain blank for approximately 20 seconds, while the unit performs a self-test. The device will then attempt to obtain network settings from a DHCP server.



When network settings are obtained from the network DHCP server, the device will display the assigned DHCP IP address for 5 seconds. The IP address can then be used to configure the device over a network using telnet, SSH, HTTP or SSL (HTTPS) sessions.

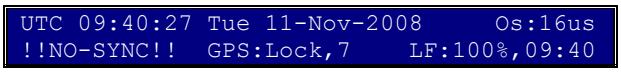


If no DHCP server is present on the network, the device will not be assigned an IP address. Configuration will therefore need to be carried out using the serial RS232 console connection to a PC serial port and dumb terminal emulator, see section ‘Console Configuration’.

LCD Display – Initial Operation

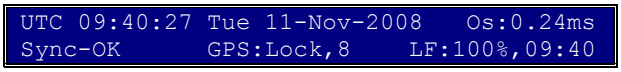
When network settings have been obtained, the device will then show its normal status display. The current UTC (Coordinated Universal Time) time and date, which is held internally by the devices real-time clock, will be shown. The current time offset compared to any available external time references will be shown, this defaults to 16usec on start-up. Synchronisation ‘Sync-Init’ indicates that the device is waiting for external time references to come online. GPS status ‘GPS:NoLock,0’ indicates that no GPS satellite lock has yet been achieved. LF radio status ‘LF:Nsig,Init’ indicates that no LF radio signal is currently being received.

When a GPS or radio antenna is installed and a signal lock is achieved, time-stamps will be passed to NTP from the reference clock. NTP will then enter a calibration mode for a period of 10 to 15 minutes, while its internal clock is being skewed towards the correct time. During this period, the unit will still be in an unsynchronised state and will display ‘!!NO SYNC!!’, as indicated below.



LCD Display – Normal Operation

When the device is synchronised, the LCD display will typically appear as follows.



UTC	The current synchronised time maintained by the device. This is displayed as UTC time (Coordinated Universal Time).
Os	The current offset, or estimated error, between the maintained time and the external reference clock. This may vary according to the external reference clock that is currently being used and also with the SR series model.
Sync-OK	Denotes that the device is synchronised and can serve network time clients with the correct time.

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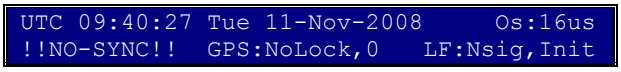
GPS:Lock,8 Signifies that a GPS signal lock has been achieved along with the number of satellites in currently in use. If no GPS antenna is connected to the device and other external clock references are being utilised, this field will remain as 'GPS:NoLock,0'.

LF:100%,09:40 Signifies that a good (100%) radio signal is currently being received along with the time of the last correctly decoded LF time-stamp. If the indicator falls below 100% then broadcast time-stamp data is being lost, which will result in failure to decode transmitted time and date information. The time indicates the last correctly decoded broadcast LF radio time stamp. Most radio transmissions broadcast time data each minute, therefore, ideally this time should increment each minute as new timestamps are received.

LCD Display – Device Unsynchronised

If no external reference clock synchronisation has been possible for a period of time, eventually the display will show '!!NO-SYNC!!' indicating that the device has entered an unsynchronised mode and will no longer provide synchronisation to network time clients.



LCD Display – Internal Manual Time Adjustment Required

If the device has been powered off for an extended period, the internal time stored in the real-time clock may have drifted too far away from the correct time in order for the device to synchronise correctly. The GPS status or the LF radio status will show 'BAD' indicating too great a difference between the received reference clock time-stamp and the devices system time.

In this event the real-time clock will need to be adjusted to within 10 minutes of the correct time from a telnet session, see section 'Correcting the System Time'.

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Correcting the System Time

If the device has been powered off for an extended period of time, the units system time, stored in its battery-backed real-time clock may have drifted too far away from the correct time in order for synchronisation to correctly occur. The LCD or web configuration fields GPS status or LF radio status will show 'Bad' when a GPS or radio signal lock is achieved.

In this event, the unit's system time will need to be adjusted manually to within 10 minutes of the correct UTC time. This can be done by opening a telnet session and logging into the device and using the 'setclock' command.

```
C:\>telnet 192.168.0.10                  # where 192.168.0.10 is the IP address of the NTP server.
Linux 2.4.31 (NTP001) (0)
NTP001 login: admin                      # username: admin
password:admin                           # default password: admin
BusyBox v1.00 (2005.06.29-14:57+0000)
Built-in shell (ash)
Enter 'help' for a list of built-in commands.

/tmp/admin $ setclock 081214222010       # set the devices system time (UTC)
Thu Aug 12 14:22:00 UTC 2010
/tmp/admin $ exit                        # exit the telnet session
Connection to host lost.
C:\>
```

The setclock command has the following syntax:

setclock mmddHHMMyyyy

where:

mm is the month of the year	- 2 digits, range 1 - 12
dd is the day of the month	- 2 digits, range 1 - 31
HH is the hour of the day	- 2 digits, range 0 - 23
MM is the minute of the hour	- 2 digits, range 0 - 60
yyyy is the current year	- 4 digits, range 1000 - 9999

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SR Series System Logs

System Log

File Location: /tmp/admin/messages
View using: 'cat /tmp/admin/messages' from console or use FTP or Web interface

```
Dec 28 11:12:13 (none) syslog.info syslogd started: BusyBox v1.00 (2005.06.29-14:57+0000)
Dec 28 11:12:13 (none) daemon.info inetd[76]: Online and ready (2 sockets)
Dec 28 11:12:14 (none) daemon.info LCD[84]: Starting LCD display handler daemon. LCD Handler 1.1.000
Dec 28 11:12:14 (none) daemon.notice ntpd[89]: ntpd 4.2.0@1.1161-r Sun Dec 11 15:28:12 GMT 2005 (3)
Dec 28 11:12:14 (none) daemon.debug ntpd[89]: signal_no_reset: signal 13 had flags 4000000
Dec 28 11:12:14 (none) daemon.info ntpd[89]: precision = 2.000 usec
Dec 28 11:12:14 (none) daemon.info ntpd[89]: kernel time sync status 0040
Dec 28 11:12:14 (none) daemon.info ntpd[89]: frequency initialized 8 PPM from /tmp/config/ntp.drift
Dec 28 11:16:33 (none) daemon.info ntpd[89]: synchronized to SHM(0), stratum=0
Dec 28 11:16:33 (none) daemon.notice ntpd[89]: kernel time sync disabled 0041
Dec 28 11:17:39 (none) daemon.notice ntpd[89]: kernel time sync enabled 0001
```

NTP LoopStats

File Location: /tmp/admin/loopstats
View using: 'cat /tmp/admin/loopstats' from console or use FTP or Web interface
Days Kept: 3 days, stored as /tmp/admin/loopstats.yyyymmdd
Description: Records loop filter statistics information. Each update of the local clock outputs a line of the following form to the file generation set named `loopstats`:

```
50935 75440.031 0.000006019 13.778190 0.000351733 0.0133806
```

The first two fields show the date (Modified Julian Day) and time (seconds and fraction past UTC midnight). The next five fields show time offset (seconds), frequency offset (parts per million - PPM), RMS jitter (seconds), Allan deviation (PPM) and clock discipline time constant.

NTP ClockStats

File Location: /tmp/admin/clocklog-gps-yyyymmdd where yyyymmdd is the current date.
View using: 'cat /tmp/admin/clocklog-gps-yyyymmdd ' from console or use FTP
Days Kept: 1 day
Description: Records GPS reference clock statistics information. Each update of the local clock outputs a line of the following form to the file generation set named `clocklog-gps`:

```
29.12.2005-16:20:29) GPS Time Received: 16:20:30 29-12-2005 [UTC]
```

The first field records the time and date the reference clock time stamp was received followed by the received time stamp.

File Location: /tmp/admin/clocklog-lf-yyyymmdd where yyyymmdd is the current date.
View using: 'cat /tmp/admin/clocklog-lf-yyyymmdd ' from console or use FTP
Days Kept: 1 day
Description: Records LF (MSF\DCF-77) reference clock statistics information. Each update of the local clock outputs a line of the following form to the file generation set named `clocklog-lf`:

```
29.12.2005-16:20:29) MSF Time Received: 16:20:30 29-12-2005 [UTC]
```

The first field records the time and date the reference clock time stamp was received followed by the received time stamp.

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Appendix A: Specifications

Firmware

Linux Version:	2.4.31
Supported Protocols	NTP 4.2.0, SNTP, TCP/IP, Telnet, FTP, HTTP, RS232 Console
Supported Secure Configuration Protocols	HTTPS, SSH (SR9xxx\SC9xxx models only)
Compatible Clients	NTP2, NTP3, NTP4, SNTP3, SNTP4

Hardware

Ethernet:	10/100 BaseT RJ45 Auto sensing
Enclosure:	1U High 19" Rack-mountable
Construction:	1.8mm Aluminium
Dimensions:	483 x 205 x 44 mm
Weight:	2.2Kg
Operating Temperature:	0C ~ +50C (SR Series) 0C ~ +70C (SC Series)
Power Supply	Universal 100-240 VAC 50-60 Hz CE/UL/CSA Approved PSU
Power Consumption (typical):	5W approx.
Heat Output (typical):	18 Btu/Hr

GPS Receiver Specification – SRxxxx-10 and SCxxxx-10 models

Accuracy (24 hr static)	
Horizontal	.<2.5 m 50%, <5 m 90%
SBAS	.<2.0 m 50%, <4 m 90%
Altitude	<5 m 50%, <8 m 90%
SBAS	<3 m 50%, <5 m 90%
Velocity	0.06 m/sec
Static PPs	.+/- 60ns RMS
PPS (Stationary Mode "indoor" @ -145dBm)	. +/-350ns
Acquisition (Autonomous, -130dBm, 50%)	
Reacquisition	2 s
Hot Start	3 s
Warm Start	35 s
Cold Start	38 s
Sensitivity (unaided)	
Tracking	.-160 dBm
Acquisition	.-148 dBm
Receiver Dynamics	2G
GPS Antenna Connector	TNC Female

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Appendix B: DATASHEET - SR SERIES

KEY FEATURES

Linux based true Stratum 1 NTP time servers

Industry leading 5 year warranty

12 channel GPS, MSF, DCF-77 and dual reference clock options

Rugged, compact, 1U high rack-mountable enclosure

Very low power consumption aiding reliability

High stability TCXO options for extended holdover

Secure, easy to use HTPPS / SSL / SSH configuration

BENEFITS

Synchronize thousands of network time clients

Accurately synchronize time critical processes

Accurate, traceable time reference inside your firewall

Reliable timing information derived from atomic time

Simple to install, configure and maintain

WARRANTY & SUPPORT

COMPLIANCE

PRODUCT OVERVIEW

TimeTools new SR Series NTP servers provides a complete range of Linux based true Stratum 1 NTP Network Time Servers that provide a real breakthrough in price and performance.

Housed in a rugged, yet compact, 1U high, rack-mountable enclosure, the SR series takes up minimal valuable rack-space.

By utilising a customized Linux kernel and an unmodified version of the latest network time protocol distribution, NTP version 4.2, the SR series offers true NTP / SNTP functionality.

"The SR series provides a reliable, highly accurate, traceable, source of time inside your firewall".

!!! UPDATE !!! The SR series is now provided with a cutting-edge high-sensitivity GPS receiver that can often operate with an indoor located GPS antenna. Additionally, the new receivers can operate from a single satellite-in-view making operation from a window often possible. These features potentially provide a great saving on installation costs when compared to traditional roof-mounted GPS antennas. Of course, our GPS antennas are completely weather-proof and can still be roof-mounted, if required.

Multiple Reference Clock Options

Multiple optional external reference clock combinations can be provided with the SR series; GPS, MSF radio, DCF-77 radio and dual GPS / radio reference capabilities. The SR series provides true flexibility.

High Stability and Performance

High-stability disciplined TCXO oscillator options are available to maintain accurate time for extended periods in the event of GPS / radio reference clock signal loss.

Secure Configuration and Maintenance

An easy to use password-protected user interface (HTTP / HTTPS / SSL / SSH) is provided for system configuration and management. FTP can be utilised to download NTP statistics and upload firmware upgrades, provided by TimeTools free of charge.

5-Year Warranty

The SR Series NTP Server is a low-power convection cooled device with no moving parts, aiding long-term reliability. Our confidence in the reliability of the device is reflected in the provision of an industry leading 5-year warranty.

SR7110

The SR7110 is an entry-level Linux based true NTP time server at a highly competitive price. It can utilise GPS or LF radio time references to provide stratum 1 NTP functionality, ideal for synchronising digital wall clocks and smaller networks.

SR9210

The mid-range SR9210 provides a high specification NTP network time reference. It incorporates a high-throughput Ethernet network interface, combined with the ability to accept GPS, LF radio or dual reference GPS / LF radio external time references. The SR9210 is an ideal time reference where a large number of network time clients are to be synchronised accurately and reliably.

SR9750 / SR9850

The top-of-range SR9750 and SR9850 has all of the advanced features of the SR9210 but also incorporates a high-stability GPS / LF disciplined Temperature Controlled Crystal Oscillator (TCXO). The high precision TCXO backup reference clock provides extended holdover periods in the event of primary reference signal loss.

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Product Comparison Chart

Model	SR 7110	SR 9210	*SR 9750*	*SR 9850*
Timing Protocols				
NTP v2, v3, v4	✓	✓	✓	✓
SNTP	✓	✓	✓	✓
NTP Peering		✓	✓	✓
NTP Multicast		✓	✓	✓
NTP Broadcast		✓	✓	✓
NTP MD5 Authentication		✓	✓	✓
NTP Requests / Second (typical)	> 200	> 1,000	> 1,000	**> 2,500**
Maximum Number of NTP Clients (typical)	> 12,000	> 64,000	> 64,000	**> 160,000**
NMEA RS232 Output		✓	✓	✓
Time Reference Options				
12 Channel GPS Receiver – High Sensitivity Indoor, Over-Determined Clock, Single Satellite Operation	✓	✓	✓	✓
LF - MSF (UK) Reference Clock	✓	✓	✓	✓
LF - DCF-77 (German) Reference Clock	✓	✓	✓	✓
Dual GPS and LF Radio Reference Clocks		✓	✓	✓
Configuration Protocols				
HTTP (Web) / HTTPS (SSL Secure Sockets Layer)		✓	✓	✓
SSH (Secure Shell)		✓	✓	✓
TELNET	✓	✓	✓	✓
FTP	✓	✓	✓	✓
Console (RS232)	✓	✓	✓	✓
DHCP		✓	✓	✓
Oscillator Options				
Standard Crystal Oscillator	✓	✓		
High Stability GPS\LF Disciplined TCXO Oscillator			✓	✓
Timing (typical)				
GPS Accuracy	1 msec UTC	60 nsec UTC	60 nsec UTC	60 nsec UTC
LF Accuracy	10 –50 msec	1 –20 msec	1 –20 msec	1 –20 msec
NTP Accuracy (GPS Synchronised)	< 10 msec UTC	< 250 usec	< 250 usec	**< 5 usec**
24 Hour TCXO Holdover (GPS disciplined, typical @ 25C)	-	-	< ± 10 msec ($2.3e10^{-7}$)	**< ± 4.3 msec ($1e10^{-7}$)**
Optional Buffered 1 PPS Output on BNC		✓	✓	✓
Reporting				
Remote Syslog		✓	✓	✓
System Logging	✓	✓	✓	✓

SPECIFICATION

MECHANICAL \ ENVIRONMENTAL

- **Dimensions** 483 x 205 x 44 mm (19.0" x 8.05" x 1.73")
- **Construction** 1U High 19" Rack mount, 1.8mm Aluminium
- **Weight** approx 2.2Kg (4.84lbs)
- **Power Supply** Universal 85-264 VAC 47-440 Hz CE/UL/CSA Approved PSU
- **Power Consumption** approx 5W
- **Operating Temperature** 0C ~ +50C *(-0C ~ +70C option)*
- **Storage Temperature** -10C ~ +60C *(-20C ~ +80C option)*
- **Relative Humidity** 95% non-condensing
- **Approvals** CE, EN61000-6-1, EN61000-6-3, FCC

INPUT \ OUTPUT

- **LAN** 10/100 Mbit BaseT , RJ45 auto-sensing
- **Serial Console:** 9 way 'D' RS232, 9600, N, 8, 1
- **GPS Antenna Input** TNC female
- **LF/AUX Input:** 9 way 'D'
- **Power:** Double Fused IEC Inlet
- **PPS:** Buffered pulse per second output on BNC (optional)

INTEGRAL GPS RECEIVER

- **Type**: 12 Channel, L1 1575.42 MHz, High Sensitivity
- **Features**: High sensitivity, Over-determined clock modes
- **Timing:** GPS Time Traceable to UTC (USNO)
- **Accuracy (typical):** +/- 60 nsec UTC
- **Acquisition (Cold Start):** 38 sec

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GPS and LF Antenna Options and Accessories

Jam-Resistant GPS Antenna
The TWS3978 high gain permanent mount GPS antenna is ideal for timing applications such as the SR Series. It features a perfectly tuned custom ceramic patch element for maximum signal reception, ESD circuit protection, a very low noise (0.5 dB) 3 stage LNA circuit and a SAW filter, enabling the TWS3978 to provide a reliable and clear GPS signal while minimizing loss-of-lock, even when conditions are less than ideal.

MXS / DXS Ultra High Gain Radio Antenna
The MXS / DXS LF antenna is a unidirectional ultra-high gain ferrite antenna for the SR series NTP servers. The highly sensitive active antenna is ideal for low signal strength areas. The antenna is available in MSF (UK) and DCF-77 (German) transmitter versions. The antenna is provided with 5m of cable which can easily be extended up to 100m using RG58 coax.

LF / GPS Over Optical Fibre
A LF / GPS over fibre system allows RF radio and GPS signals to be transmitted with minimal losses over long cable distances. It provides a secure and interference free link through noisy environments. The technology transparently provides cross-site connection between a LF radio / GPS antenna and receiver unit.

GPS Surge Suppressor
The SPP-GPS is a multi-strike, maintenance free GPS surge suppressor. It protects valuable network equipment from potential lightning strikes and other voltage surges.

GPS Inline Amplifier – 20db
The GPS inline amplifier offers an extra 20db of gain on top of the antenna gain. This allows for extended GPS cable runs beyond 100m, depending on cable types.

GPS Splitters – 2 to 32 Way Options
TimeTools can provide a range of GPS splitters to allow multiple GPS devices to share a single GPS antenna. Available with a range of outputs in either compact or rack-mount enclosures.

Product Codes

SR Series NTP Time Servers

SR 7110 GPS \ LF NTP Server	SR7110-00
SR 9210 GPS \ LF \ Dual Reference NTP Server	SR9210-00
SR 9750 GPS \ LF \ Dual Reference NTP Server with TCXO	SR9750-00
SR 9850 GPS \ LF \ Dual Reference NTP Server with TCXO	SR9850-00

Scope of Supply: *SR Series NTP Time Server, IEC Mains Lead, Console Configuration Cable, Product User Guide and NTP Client CD.*

Optional SR Series LF (Radio) Reference Clock Antennas

High-Gain MSF (UK) Active Antenna	SR-MLS-00
High-Gain DCF-77 (German) Antenna	SR-DLS-00
Ultra-High-Gain MSF (UK) Antenna	SR-MXS-00
Ultra-High-Gain DCF-77 (German) Antenna	SR-DXS-00

Optional SR Series GPS Reference Clock Antennas and Accessories

Jam-Resistant Pole Mounting GPS Antenna and Mount	T-WS3978
30m RG58 Cable	TCX-030
50m RG58 Cable	TCX-050
Additional cable lengths available on request	
GPS Surge Suppressor	SPP-GPS
GPS Amplifier – 20db	T-AD200-8
LF / GPS over optical fibre systems	P.O.A
GPS Splitters – 2 to 32 way, compact or rack-mount	P.O.A

TimeTools Limited has relied on representations made by its suppliers in certifying this product as RoHS compliant.

TimeTools Limited is not responsible for the operation or failure of operation of GPS satellites or LF time & frequency broadcasts or the availability of GPS satellite or LF radio signals.

In no event will TimeTools Limited be liable for any indirect, special, incidental, or consequential damages from the sale or use of this product. This disclaimer applies both during and after the term of the warranty. TimeTools Limited disclaims liability for any implied warranties, including implied warranties of merchantability and fitness for a specific purpose.

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Appendix C: DATASHEET - SC SERIES

KEY FEATURES

Linux based true Stratum 1 NTP time servers

Industry leading 5 year warranty

12 channel GPS, MSF, DCF-77 and dual reference clock options

Rugged, compact, Aluminium enclosure

Very low power consumption aiding reliability

High stability TCXO options for extended holdover

Secure, easy to use HTTPS / SSL / SSH configuration

BENEFITS

Synchronize thousands of network time clients

Accurately synchronize time critical processes

Accurate, traceable time reference inside your firewall

Reliable timing information derived from atomic time

Simple to install, configure and maintain

WARRANTY & SUPPORT

COMPLIANCE

PRODUCT OVERVIEW

TimeTools new SC Series NTP servers provides a complete range of Linux based true Stratum 1 NTP Network Time Servers that provide a real breakthrough in price and performance.

The SC Series are compact NTP servers, housed in rugged, aluminium enclosures. Ideal for applications with space saving requirements.

By utilising a customized Linux kernel and an unmodified version of the latest network time protocol distribution, NTP version 4.2, the SC series offers true NTP / SNTP functionality.

"The SC series provides a reliable, highly accurate, traceable, source of time inside your firewall".

!!! UPDATE !!! The SR series is now provided with a cutting-edge high-sensitivity GPS receiver that can often operate with an indoor located GPS antenna. Additionally, the new receivers can operate from a single satellite-in-view making operation from a window often possible. These features potentially provide a great saving on installation costs when compared to traditional roof-mounted GPS antennas. Of course, our GPS antennas are completely weather-proof and can still be roof-mounted, if required.

Multiple Reference Clock Options

Multiple optional external reference clock combinations can be provided with the SC series; GPS, MSF radio, DCF-77 radio and dual GPS / radio reference capabilities. The SC series provides true flexibility.

High Stability and Performance

High-stability disciplined TCXO oscillator options are available to maintain accurate time for extended periods in the event of GPS / radio reference clock signal loss.

Secure Configuration and Maintenance

An easy to use password-protected user interface (HTTP / HTTPS / SSL / SSH) is provided for system configuration and management. FTP can be utilised to download NTP statistics and upload firmware upgrades, provided by TimeTools free of charge.

5-Year Warranty

The SC Series NTP Server is a low-power convection cooled device with no moving parts, aiding long-term reliability. Our confidence in the reliability of the device is reflected in the provision of an industry leading 5-year warranty.

SC7105

The SC7105 is an entry-level Linux based true NTP time server at a highly competitive price. It can utilise GPS or LF radio time references to provide stratum 1 NTP functionality, ideal for synchronising digital wall clocks and smaller networks.

SC9205

The mid-range SC9205 provides a high specification NTP network time reference. It incorporates a high-throughput Ethernet network interface, combined with the ability to accept GPS, LF radio or dual reference GPS / LF radio external time references. The SC9205 is an ideal time reference where a large number of network time clients are to be synchronised accurately and reliably.

SC9705

The top-of-range SC9705 has all of the advanced features of the SC9205 but also incorporates a high-stability GPS / LF disciplined Temperature Controlled Crystal Oscillator (TCXO). The high precision TCXO backup reference clock provides extended holdover periods in the event of primary reference signal loss.

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Product Comparison Chart

Model	SC 7105	SC 9205	*SC 9705*
Protocols			
NTP v2, v3, v4	✓	✓	✓
SNTP	✓	✓	✓
NTP Peering		✓	✓
NTP Multicast		✓	✓
NTP Broadcast		✓	✓
NTP MD5 Authentication		✓	✓
NTP Requests / Second (typical)	> 200	> 1,000	> 1,000
Maximum Number of NTP Clients (typical)	> 12,000	> 64,000	> 64,000
NMEA RS232 Output		✓	✓
Time Reference Options			
12 Channel GPS Receiver – High Sensitivity Indoor, Over-Determined Clock, Single Satellite Operation	✓	✓	✓
LF - MSF (UK) Reference Clock	✓	✓	✓
LF - DCF-77 (German) Reference Clock	✓	✓	✓
Dual GPS and LF Radio Reference Clocks		✓	✓
Configuration Protocols			
HTTP (Web) / HTTPS (SSL Secure Sockets Layer)		✓	✓
SSH (Secure Shell)		✓	✓
TELNET	✓	✓	✓
FTP	✓	✓	✓
Console (RS232)	✓	✓	✓
DHCP		✓	✓
Oscillator Options			
Standard Crystal Oscillator	✓	✓	
High Stability GPS\LF Disciplined TCXO Oscillator			✓
Timing (Typical)			
GPS Accuracy	1 msec UTC	60 nsec UTC	60 nsec UTC
LF Accuracy	10 –50 msec	1 –20 msec	1 –20 msec
NTP Accuracy	< 10 msec UTC	< 250 usec	< 250 usec
24 Hour TCXO Holdover (GPS disciplined, typical @ 25C)	-	-	< ± 10 msec ($2.3e10^{-7}$)
Optional Buffered 1 PPS Output on BNC		✓	✓
Reporting			
Remote Syslog		✓	✓
System Logging	✓	✓	✓

SPECIFICATION

MECHANICAL \ ENVIRONMENTAL

- **Dimensions** 168 x 165 x 54 mm (6.5" x 6.5" x 2.2")
- **Construction** 1.8mm Aluminium
- **Weight** approx 0.8Kg (1.8lbs)
- **Power Supply** Universal 85-264 VAC 47-440 Hz CE/UL/CSA Approved PSU
- **Power Consumption** approx 5W
- **Operating Temperature** 0C ~ +70C
- **Storage Temperature** -20C ~ +85C
- **Relative Humidity** 95% non-condensing
- **Approvals** CE, EN61000-6-1, EN61000-6-3, FCC

INPUT \ OUTPUT

- **LAN** 10/100 Mbit BaseT , RJ45 auto-sensing
- **Serial Console:** 9 way 'D' RS232, 9600, N, 8, 1
- **GPS Antenna Input** TNC female
- **LF/AUX Input:** 9 way 'D'
- **Power:** Double Fused IEC Inlet
- **PPS:** Buffered pulse per second output on BNC (optional)

INTEGRAL GPS RECEIVER

- **Type**: 12 Channel, L1 1575.42 MHz
- **Features**: High sensitivity, Over-determined clock modes
- **Timing:** GPS Time Traceable to UTC (USNO)
- **Accuracy (typical):** +/- 60 nsec UTC
- **Aquistion (Cold Start):** 38 sec

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GPS and LF Antenna Options and Accessories

Jam-Resistant GPS Antenna
The TWS3978 high gain permanent mount GPS antenna is ideal for timing applications such as the SC Series. It features a perfectly tuned custom ceramic patch element for maximum signal reception, ESD circuit protection, a very low noise (0.5 dB) 3 stage LNA circuit and a SAW filter, enabling the TWS3978 to provide a reliable and clear GPS signal while minimizing loss-of-lock, even when conditions are less than ideal.

MXS / DXS Ultra High Gain Radio Antenna
The MXS / DXS LF antenna is a unidirectional ultra-high gain ferrite antenna for the SC series NTP servers. The highly sensitive active antenna is ideal for low signal strength areas. The antenna is available in MSF (UK) and DCF-77 (German) transmitter versions. The antenna is provided with 5m of cable which can easily be extended up to 100m using RG58 coax.

LF / GPS Over Optical Fibre
A LF / GPS over fibre system allows RF radio and GPS signals to be transmitted with minimal losses over long cable distances. It provides a secure and interference free link through noisy environments. The technology transparently provides cross-site connection between a LF radio / GPS antenna and receiver unit.

GPS Surge Suppressor
The SPP-GPS is a multi-strike, maintenance free GPS surge suppressor. It protects valuable network equipment from potential lightning strikes and other voltage surges.

GPS Inline Amplifier – 20db
The GPS inline amplifier offers an extra 20db of gain on top of the antenna gain. This allows for extended GPS cable runs up to and beyond 100m depending on cable types.

GPS Splitters – 2 to 32 Way Options
TimeTools can provide a range of GPS splitters to allow multiple GPS devices to share a single GPS antenna. Available with a range of outputs in either compact or rack-mount enclosures.

Product Codes

SC Series NTP Time Servers

SC 7105 GPS \ LF NTP Server	SC7105-00
SC 9205 GPS \ LF \ Dual Reference NTP Server	SC9205-00
SC 9705 GPS \ LF \ Dual Reference NTP Server with TCXO	SC9705-00

Scope of Supply: *SC Series NTP Time Server, IEC Mains Lead, Console Configuration Cable, Product User Guide and NTP Client CD.*

Optional SC Series LF (Radio) Reference Clock Antennas

High-Gain MSF (UK) Active Antenna	SR-MLS-00
High-Gain DCF-77 (German) Antenna	SR-DLS-00
Ultra-High-Gain MSF (UK) Antenna	SR-MXS-00
Ultra-High-Gain DCF-77 (German) Antenna	SR-DXS-00

Optional SC Series GPS Reference Clock Antennas and Accessories

Jam-Resistant Pole Mounting GPS Antenna and Mount	T-WS3978
30m RG58 Cable	TCX-030
50m RG58 Cable	TCX-050
Additional cable lengths available on request	
GPS Surge Suppressor	SPP-GPS
GPS Amplifier – 20db	T-AD200-8
LF / GPS over optical fibre systems	P.O.A
GPS Splitters – 2 to 32 way, compact or rack-mount	P.O.A

TimeTools Limited has relied on representations made by its suppliers in certifying this product as RoHS compliant.

TimeTools Limited is not responsible for the operation or failure of operation of GPS satellites or LF time & frequency broadcasts or the availability of GPS satellite or LF radio signals.

In no event will TimeTools Limited be liable for any indirect, special, incidental, or consequential damages from the sale or use of this product. This disclaimer applies both during and after the term of the warranty. TimeTools Limited disclaims liability for any implied warranties, including implied warranties of merchantability and fitness for a specific purpose.

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Appendix D: Optional LF Radio Antenna

The SR Series NTP Server can be supplied with either MSF or DCF-77 radio antennas. The MSF transmitter is located at Anthorn, Cumbria, UK. The coverage of the MSF transmitter is the whole of the British Isles and can often be received in much of North Western Europe. The DCF-77 transmitter is located at Frankfurt, Germany. The coverage of the DCF-77 transmitter is Central and North-Western Europe.

Four versions of LF radio antenna are available with the SR Series NTP Server.

MLS - TimeTools Standard MSF radio antenna.
DLS - TimeTools Standard DCF-77 radio antenna.
MXS - TimeTools High Gain MSF radio antenna for weak signal strength areas.
DXS - TimeTools High Gain DCF-77 radio antenna for weak signal strength areas.

MLS \ DLS Antenna Installation

The MLS\DLS LF antenna is a unidirectional active ferrite antenna. The antenna should be installed in a horizontal plane at right angles to the source of the radio transmission. The antenna incorporates a red\green LED which flashes in tune to the LF radio transmission. Ideally, the antenna needs to be located where a consistent red\green flash can be observed once per second. If the antenna LED flashes erratically or if the LED is completely red or green, the antenna may need to be relocated.

The antenna can be located up to 100m from the time server using CAT3 or better patch lead or structured cabling.

Fig: MLS \ DLS LF Radio Antenna

Dimensions:	Length 76mm; Width: 35mm; Height: 20mm
Weight:	180g
Connector:	9 way ‘D’ female
Cable length:	2m
Maximum Cable Length:	100m (CAT3 or better, serial extension cable)

MXS \ DXS Antenna Installation

The MXS\DXS LF antenna is a unidirectional high-gain active ferrite antenna ideal for low signal strength areas. The antenna should be installed in a horizontal plane at right angles to the source of the radio transmission. The antenna incorporates a red\green LED which flashes in tune to the LF radio transmission. Ideally, the antenna needs to be located where a consistent red\green flash can be observed once per second. If the antenna LED flashes erratically or if the LED is completely red or green, the antenna may need to be relocated.

The antenna is provided with 5m of cable which can be extended up to 100m using RG58 coax.

Fig: MXS \ DXS High Gain LF Radio Antenna

Dimensions:	Length 210mm; Diameter: 20mm;
Weight:	200g
Connector:	BNC male
Cable length:	5m
Maximum Cable Length:	100m (RG58)

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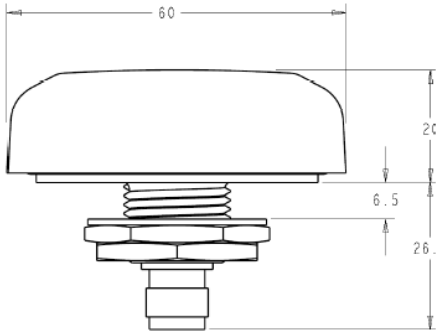
Appendix E: Optional High-Gain GPS Antenna



Environmental Specifications

Operating temp: -40c to +85c (-45c to +85c storage)
Weather Proof: IP67

Mechanical

Dimensions: 60 mm dia. x 21 mm H
Weight: 50g
Housing: GE Lexan EXL9330,
Mounting: ¾" thru-hole or bracket mount
Connector: TNC jack connector
Shock: Vertical axis 50G, Other axes 30G
Vibration: 3 axis, sweep = 15 min
10 –200 Hz log sweep: 3G

Antenna Response

Frequency: 1575.42 MHz
Gain: @ 90° 3 dBic
@ 20° -2.0 dBic
Polarization: Right Hand Circular
Axial ratio: @ 90° 4 dB
@ 20° 6 dB

Electrical

Voltage: 2.7 to 5.5 VDC
Current: 15mA
ESD circuit protection: 15KV

LNA Specifications

Frequency: 1572.5 – 1578 MHz
Output Impedance: 50 Ohm
VSWR: 1.5:1 max (at connector)
Gain: 40 dB (typical)
Noise figure: 0.5 dB (typical)

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Appendix F: Optional GPS Surge Suppressor Specification

- Industries best RF performance
- Low throughput energy
- Multi-strike capability

Technical Specifications:

Current:	4Adc
Insertion Loss:	≤ 0.1dB
Freq. Range:	800-2500MHz
Mounting:	Bulkhead Flange
Operating Voltage:	+ / -6 Volts
Polarity:	+/-
Protected Side Connector:	N Female 50Ω
RF Power:	0.25 Watts
Surge Side Connector:	N Female 50Ω
Throughput Energy:	≤ 175µJ for 3kA @ 8/20µs Waveform
Turn-On Voltage:	7 Volts
Unit Impedance:	50Ω
Voltage Standing Wave Ratio:	1.1 : 1
Weatherised:	Bellcore #TA-NWT-000487 Procedure 4.11, Wind Driven (120 mph) Rain Intrusion.
UL Approved and Listed	UL497B

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Appendix G: Copyright and Permission Notices

Network Time Protocol (NTP) 4.2

```
*********************************************************************
*                                                                   *
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Attn: RMA XXXXXXX
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Dudley. DY3 1QS
UK

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